TDM Access
(Multiservice Access Platform)

3

While many vendors are terminating their legacy multiservice TDM products, RAD Data Communications continues to offer carriers, telecom operators and service providers a winning TDM service deployment strategy. This enables them to speed their return on investment in access network equipment and Local Loop plant, as well as to facilitate the rollout of a variety of new services. Most importantly, carriers can quickly generate income without incurring substantial infrastructure costs, while assuring migration to next-generation networks.

RAD's TDM Multiservice Access Platform (MAP) is based on deploying specialized equipment at the customer premises, in the Local Loop and at the carrier's point-of-presence (POP). The MAP product family includes the FCD range of dedicated multiservice network termination units as well as the Megaplex line of multiservice access multiplexers (TDM, IP and Frame Relay) and the DXC series of multiservice access nodes. All products offer built-in Last Mile solutions, such as IDSL, SHDSL and fiber optics. The Kilomux integrating multiplexer complements the MAP family, addressing bandwidth-constrained applications in the transportation, utility and government markets.

The **DXC** family of modular multiservice-access nodes provides non-blocking DS0 cross connect for up to 688 E1/T1 lines. Most of the DXC units support built-in Local Loop solutions. The DXC devices are the most compact and high density cross connects of their kind. Plug-in interface modules supporting n x 56/64 kbps, ISDN U, E1 or T1 transmission with built-in IDSL, SHDSL and fiber optic modems, E3/T3, STM-1/OC-3 are available. Inverse multiplexing capabilities for up to eight E1/T1 lines support high speed data, native LAN connectivity and video streaming applications.

The **FCD-155E** and **FCD-155** offer STM-1 ADM or terminal capabilities. They provide a robust and resilient alternative to access network extension in the carrier environment, offering bandwidth-efficient provisioning of Ethernet services on top of traditional TDM interfaces. It is a quick, cost-effective alternative for service deployment for utilities and transportation authorities.

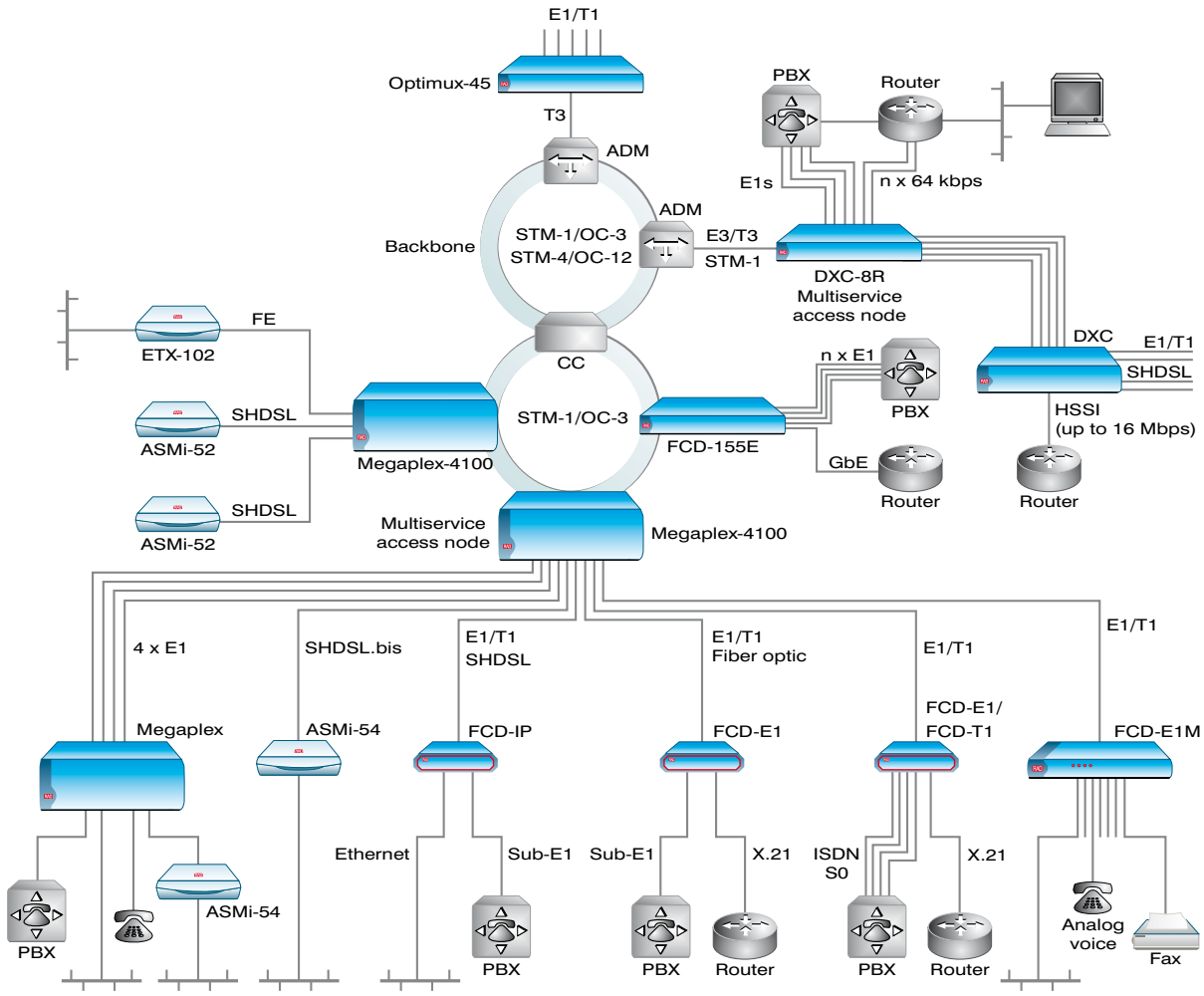
RAD's **Megaplex** family of multiservice access multiplexers offers a wide range of data, LAN and voice services. The devices come with a wide variety of analog and digital voice connections – PCM, ADPCM, G.723.1, BRI ISDN, and digital E1/T1 interfaces. These include tail-end modems and up to 80 E1/T1 lines for distributing different services over the same infrastructure and splitting these services at the POP. They also include built-in fiber optic and five SHDSL and SHDSL.bis main trunk modems. The Megaplex-4100 offers a future proof migration path to Ethernet. It serves as a central solution for Ethernet access devices as well as for TDM CPEs. It also combines STM-1/OC-3 capabilities with DS0 cross connect.

The **FCD** family of compact, low cost, multiservice network termination units (NTUs) extends the E1/T1 network to the customer premises, enabling carriers and service providers to create a flexible, service independent access model while offering a competitive and wide service portfolio.

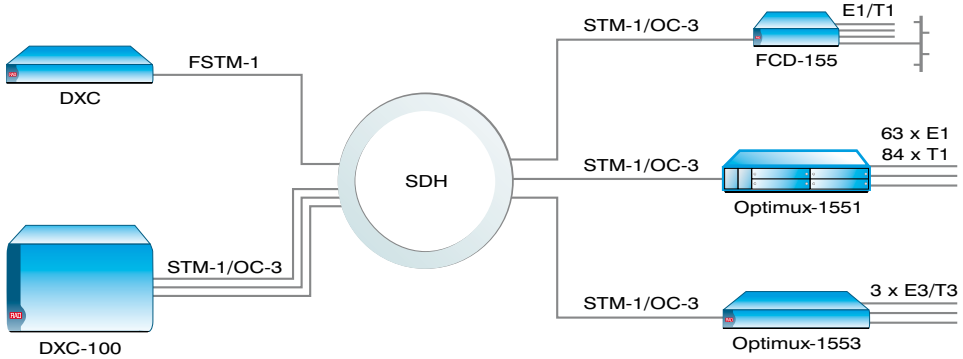
Finally, RAD's **Optimux** fiber multiplexers enable easy Ethernet and PDH extension over fiber links or service port fan-out off large capacity switches and ADMs for improved access deployment flexibility. Ranging from a few E1/T1s with or without Ethernet up to STM-1/OC-3 capacity, they offer a solution for every service extension scenario.

RAD's **Kilomux** is a subrate multiplexer for data, voice, fax, and LAN. It integrates a variety of traffic types over leased lines, ISDN, IP, and fractional E1/T1, over copper or fiber, at rates of 9.6 kbps to 1,536 kbps.

Combining award-winning, high quality voice compression techniques with maximum bandwidth utilization and a wide range of network and user interfaces, the Kilomux provides reliable point-to-point and drop-and-insert data/voice integration solutions at an affordable price, particularly attractive to the transportation, utilities and governmental markets.



Multiservice SDH access



Flexible SDH access solution

Megaplex-4100

Next-Generation Multiservice Access Node

- **Transports voice, data and advanced Ethernet services over PDH/SDH/SONET networks**
- **STM-1/OC-3 next-generation standard ADM or terminal**
- **4/1/0 non-blocking cross connect of up to 1.1 Gbps (160 Mbps TDM plus 1 Gbps Ethernet)**
- **Up to four STM-1/OC-3 ports**
- **Up to four GbE ports**
- **SHDSL access platform with up to 80 SHDSL ports**
- **Up to 80 E1/T1 ports**
- **Up to 30 Fast Ethernet ports**
- **Up to 120 n x 64 kbps or sub-DS0 rate data ports**
- **Up to 160 analog voice ports**
- **Supports selected Megaplex-2100 I/O modules**
- **Modular 4U-high, 19-inch unit with 10 slots for I/O modules**
- **SFP optional for STM-1/OC-3, GbE and Fast Ethernet ports**

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The Megaplex-4100 is a high capacity multiservice concentrator supporting access over PDH/SDH/SONET transport networks. Large organizations with SDH/SONET backbones require an efficient way to transport and provision multiple user channels of various services over their high capacity pipes.

The termination and aggregation of pure Ethernet traffic makes the Megaplex-4100 a highly effective IP/MPLS aggregator as well as a tool to better utilize the SDH/SONET bandwidth by supporting VCAT. The Megaplex-4100 does this with a large range of multiport modules that support Ethernet-based Fast Ethernet and Gigabit Ethernet services, in addition to TDM-based services, such as dedicated low speed n x 64 kbps data, high speed data (up to STM-1/OC-3), digital voice, analog voice, and ISDN.

Its ability to handle a broad range of Ethernet, data and voice services and various network technologies in a single compact managed node makes the Megaplex-4100 a versatile and cost-effective next-generation multiservice access node solution.

Next-generation ADM/terminal

STM-1/OC-3 private network owners can prolong the use of existing ADM equipment or terminal multiplexers, saving replacement or expansion costs, by implementing VCAT protocols to carry the Ethernet traffic in a more efficient way and minimize wasted bandwidth.

Megaplex-4100 supports STM-1/OC-3 add/drop multiplexing for grooming LAN and legacy (TDM) traffic over SDH/SONET networks.

Ethernet traffic can be mapped into one VC-4, up to three VC-3/STS-1, or up to 63 VC-12 or 84 VT-1.5. 1+1 MSP/APS redundancy is supported.

The Megaplex-4100 brings Ethernet economics and packet switching efficiency to existing SDH/SONET/TDM infrastructures. It thereby enables utilities and other private fiber network owners to reduce both operating and capital expenditures as they use their optical bandwidth for reselling revenue generating Ethernet services. For a modest investment, new business opportunities can be realized by leveraging existing equipment to support clear channel data streams and the latest high bandwidth services.

Ethernet aggregator

The Megaplex-4100 can terminate Ethernet traffic carried over E1/T1 links, or a bundle of E1/T1 lines, as well as IDSL, SHDSL or VCG in the STM-1/OC-3. This traffic can then be switched either to a different PDH/TDM trunk or to the Fast Ethernet or Gigabit Ethernet ports.

Ethernet CPE can also be connected via SFP or UTP ports of the Megaplex-4100 Fast Ethernet or GbE, and cross connected with other services.

Various users can benefit from this solution: SDH/SONET users who need to extend their network lifecycle by maximizing bandwidth; users with mixed services (Ethernet and TDM); users who do not need IP connectivity or services at this time but would like to invest in a solution that will enable a migration path; and users with two networks – SDH/SONET for voice and MPLS/IP for data.

4/1/0 DS0 cross connect

Megaplex-4100 features an internal 4/1/0 cross connect matrix of up to 160 Mbps. Traffic from any channel can be cross connected directly to any other channel. Ethernet traffic carried over copper, DSL or fiber can be either cross connected to another TDM/PDH trunk or terminated by the packet bus.

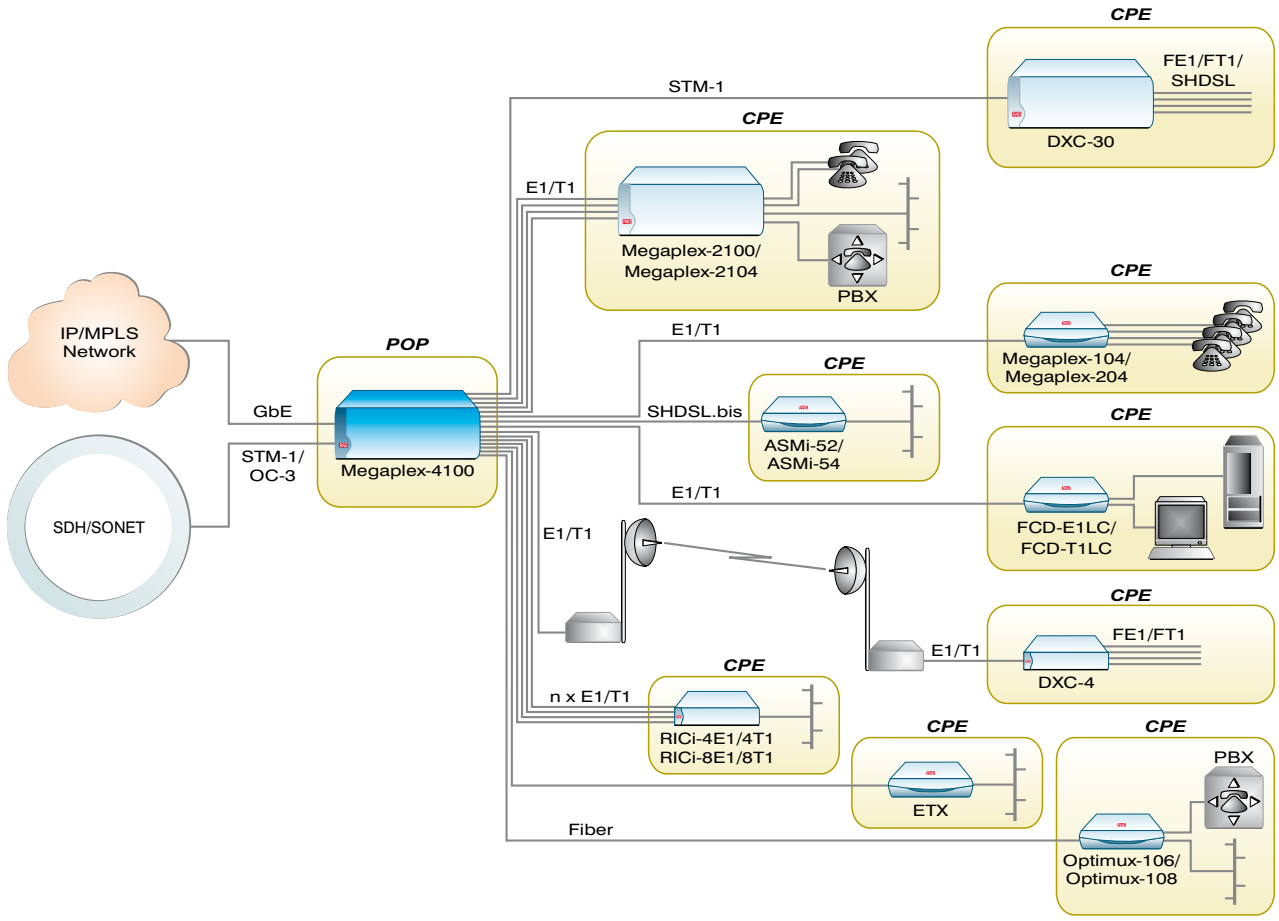
Traffic from the STM-1/OC-3 channel can be either cross connected to another STM-1/OC-3 channel on a VC-12/3 level or with any other channel.

These capabilities enable the Megaplex-4100 to function as a service differentiation point at the headquarters, handing off traditional voice and data services to the transport network.

At the remote offices or customer premises, the Megaplex-4100 may also be deployed to effectively fan out multiple voice and data services.

Multifunction node

Enterprises, campuses and utility companies can deploy two, three or even four different units in order to create an edge to the STM-1/OC-3 ring; multiplex voice, fax, data, and other low speed traffic; groom and cross connect between channels; and terminate Ethernet traffic. The Megaplex-4100 can also work opposite devices like Teleprotection modems and Omnibus units.



Single platform for corporate ring, TDM multiservice and Ethernet solutions

Diversity of rings

On top of the standard SDH/SONET ring support, the Megaplex-4100 can support E1, T1, SHDSL, or a mix of ring topologies. At sites where 1.5/2 Mbps bandwidth is enough and ring protection is required, the Megaplex-4100 provides a perfect solution in combining service provisioning and ADM capabilities.

TETRA and maritime applications

The Megaplex-4100 supports a mix of E1/T1 and SHDSL infrastructure in a 2 Mbps ring, eliminating the need for external modems in longer distance segments of the network.

One typical application is a TETRA network ring, which enables secure communications among police, fire and rescue, and ambulance crews from one central location. The system can also be used for maritime communications within territorial waters.

End-to-end management and service provisioning

The Megaplex-4100 offers carrier-class service provisioning features, including end-to-end path management, to ensure continuous service availability. Advanced SNMP management capabilities support control and monitoring of all network elements: SDH/SONET access and ring units as well as remote POP and Last Mile broadband access feeders and CPEs.

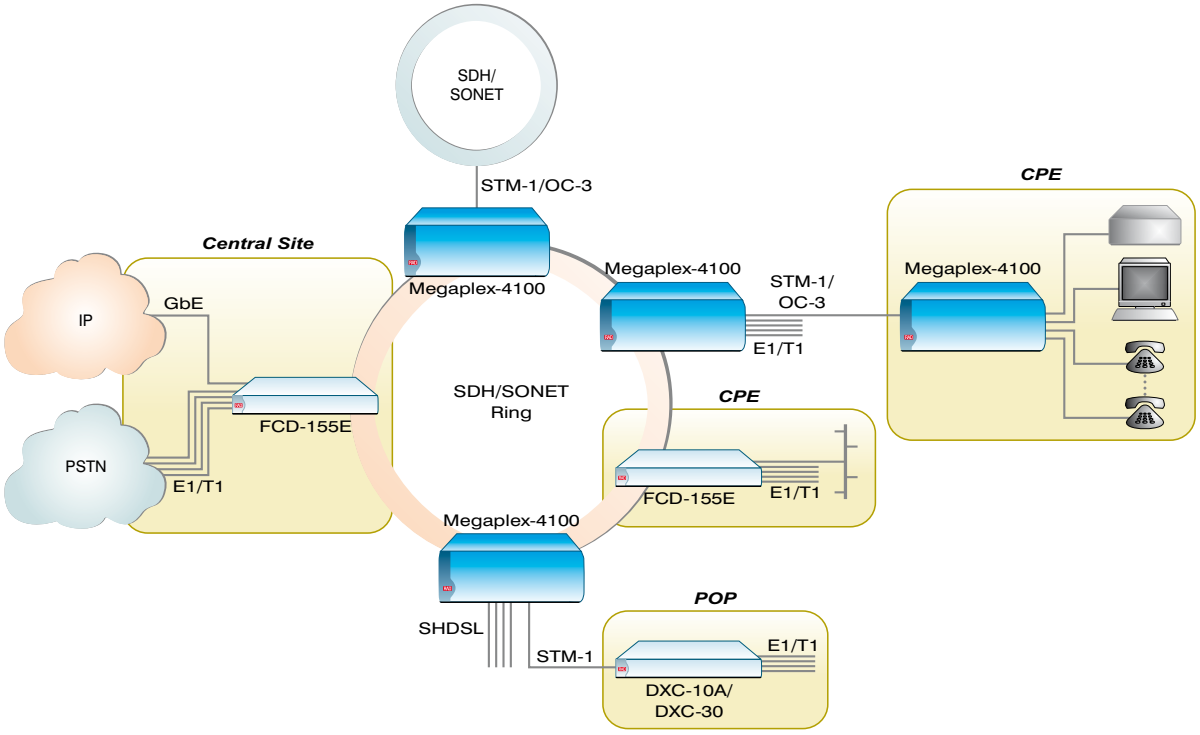
The Megaplex-4100 can be managed by the SNMP RADview-EMS multiplatform element management system service center application. Alternatively, configuration and monitoring can be performed either via Telnet or an ASCII terminal.

Carrier-class service reliability

The modular, distributed architecture of the Megaplex-4100 enables redundancy at different levels of the network and provides a resilient system with no single point of failure. Each combined common logic, cross connect matrix and broadband link module (CL) provides automatic switchover between each two links – STM-1/OC-3, GbE or both – within 50 msec, for 1+1 protection against network or cable failure.

Hardware redundancy is provided through an optional redundant power supply and CL modules, with switchover to the backup CL links within 50 msec. I/O modules can also be configured for redundancy and can be hot-swapped, allowing for continuous service.

Megaplex-4100
(Continued)



Powerful access node with carrier-class service provisioning features

CL.1 modules

The CL modules function as common logic, cross connect and broadband link modules. CL modules are available in a number of port configurations:

CL.1: Cross connect between I/O module ports with up to 7680 DS0 timeslot capacity (more than 480 Mbps)

CL.1/155: Cross connect, plus dual STM-1/OC-3 links with SFP fiber interface

CL.1/GBE: Cross connect, plus dual GbE links with UTP or SFP interface

CL.1/155GBE: Cross connect, plus dual STM-1/OC-3 links with SFP fiber interface and dual GbE links with UTP or SFP interface

Supported I/O modules

Megaplex-4100 supports up to ten I/O modules, providing a flexible and scalable platform that meets a variety of user services, including E1, T1, SHDSL, n x 64 kbps high speed data, sub-DS0 low speed data, digital voice, and analog voice:

M8E1/T1: Eight-port E1 or T1 modules. Three UTP or SFP Fast Ethernet ports on the SHDSL, T1 and E1 modules.

M8SL: Eight-port E1 over SHDSL modules. Three UTP or SFP Fast Ethernet ports on the SHDSL, T1 and E1 modules.

MPW-1: Pseudowire server module for transporting TDM services over packet switched networks

MOP-106/108: Dual 4E1/T1 and Ethernet fiber multiplexer module

ASMI-54C: G.SHDSL.bis with up to 22 Mbps over four bonded wire pairs

HS-6/12: Six- or 12-port IDSL modules

HS-RN: Four-port sub-DS0 low speed module

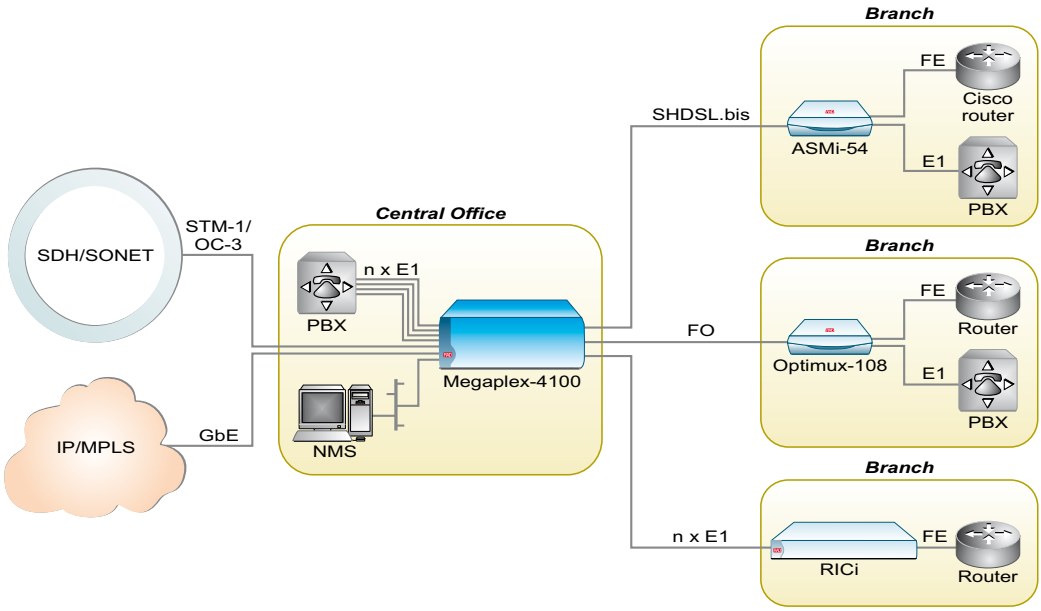
LS-6/12: Six- or 12-port low speed modules

VC-4/8/16: Four-, eight- or 16-port FXS/FXO/E&M analog voice modules

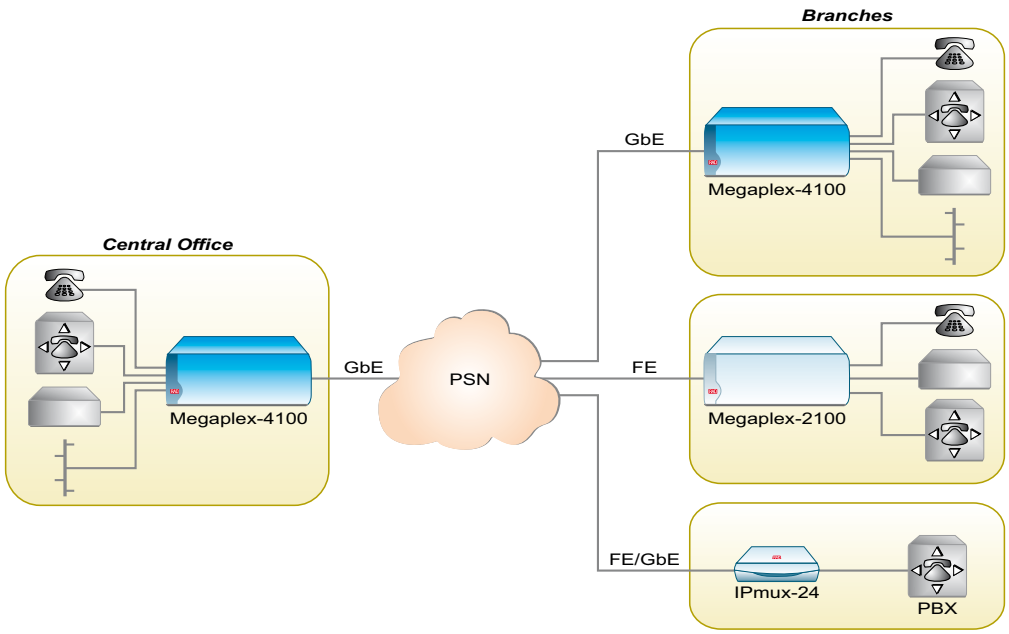
HSF-2: Dual port 10 x 64 kbps fiber IEEE C37.94 standard compliant Teleprotection module

VC-4/E&M/OMNI: Omnibus 4-wire E&M analog voice with daisy chain of 5-way digital conference calls, per channel module

HS-703: Four 64 kbps G.703, codirectional channels module



Central solution for multiple types of CPEs over copper and fiber



Single-box solution for multiservice TDM and Ethernet over PSN

Megaplex-2100, Megaplex-2104

Multiservice Access Multiplexers

TDMoIP Driven®

- **Integrated access platform for traffic grooming and cross connect**
- **Highly flexible modular multiplexer**
- **Supports multiple E1/T1 links**
- **IP main link (TDMoIP support)**
- **RFER – Resilient Fast Ethernet Ring with protection**
- **Supports E1/T1 ring protection topology**
- **Supports Omnibus for teleconference**
- **Teleprotection for power utilities**
- **PSTN, ISDN and data services**
- **R2-CAS support (transparent DTMF/ decadic)**
- **Video surveillance support**
- **Capacity:**
  - **up to 120 analog PCM voice channels**
  - **up to 160 analog ADPCM voice channels**
  - **up to 132 V.24/RS-232 low speed data channels**
  - **up to 124 n x 64 kbps data channels (V.24/RS-232 or ISDN S and U ports)**
  - **up to 44 G.703 low speed data channels**
  - **up to 600 compressed voice channels**
- **Supports multiple alternative routing schemes in event of trunk failure**
- **Integral xDSL modems for subscriber and main link connections**
- **Hot-swappable for all modules**

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The Megaplex-2100 and Megaplex-2104 are flexible, modular TDM multiplexers, enabling integration of multiple voice, ISDN, video, data, and LAN services over multiple E1/T1, Ethernet uplinks, or n x 64 links. The Megaplex main links and user ports incorporate copper, CSU/DSU, LTU, and fiber interfaces and are compatible with RAD's standalone ASMi-31, ASMi-52 and FCD modems.

The Megaplex is especially suitable for use as an economical, compact remote multiservice node for utilities and transportation. It is also ideal for small to mid-size business entities, providing mixed services for both business and residential customers. It can be deployed at the carrier's point-of-presence in the exchange, as well as at a remote distribution node, such as in an office building's basement.

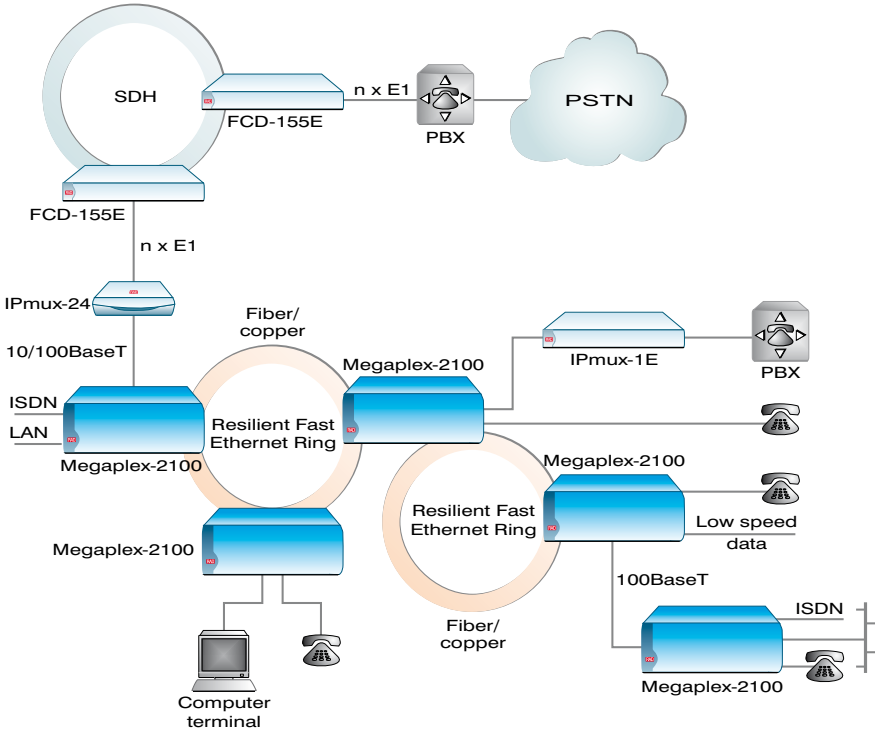
The Megaplex can be mounted in 19-inch or 21-inch racks for carrier and service provider environments.

Wide interoperability

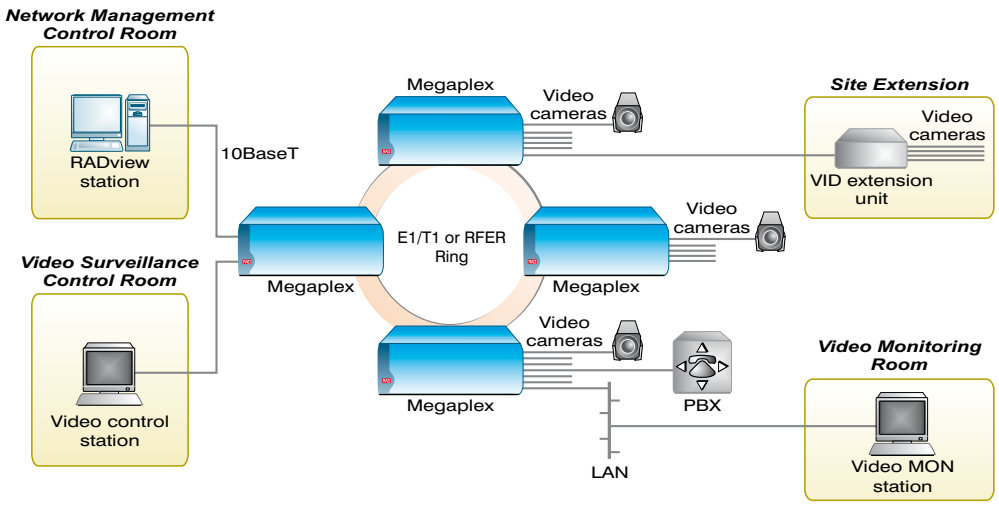
Megaplex is standards-compliant, ensuring compatibility in multivendor environments worldwide. The E1 and T1 TDM framing and signaling, PCM/ADPCM voice coding, ISDN, and data interfaces all conform to international standards.

Protection and alternative routing schemes

The single or dual E1/T1 main links support 1+1 and 1:1 protection switching for any E1/T1 or fractional E1/T1 port with non-blocking cross connect capability. This provides drop-and-insert capability between any two links on one module or between two modules. Megaplex devices store up to 10 different configuration databases and can switch between them. This feature enables alternate routing in the event of network or service failure, or at a predetermined time.



Delivering TDM and Ethernet services in a corporate network with Resilient Fast Ethernet Ring reliabilty



Ring application with video surveillance

Redundancy options

The optional redundancy on common logic, main link and power supply ensures a high level of system reliability on Megaplex hubs.

R2 support

The Megaplex also includes R2 support with transparent MFC/decadic implemented within the main link. This allows the customer to connect a legacy R2-PBX to a digital (E1 CAS) PBX, thus extending the lifespan of existing equipment.

TDM over IP support

Megaplex incorporates RAD's TDMoIP technology in the ML-IP main link module. This enables all existing TDM services to be transported over packet switched networks. With the ML-IP module, the Megaplex can be connected in a daisy-chain topology where multiple Megaplex units can be cascaded together. TDMoIP support also allows the Megaplex to operate opposite the IPmux family of TDMoIP gateways. Along with TDMoIP, Megaplex supports Resilient Fast Ethernet Ring (RFER) with under 50 msec ring restoration capabilities. Up to 40 E1 or 50 T1 TDM circuits can be connected per Fast Ethernet ring or daisy chain.

The addition of TDMoIP functionality further expands the broad scope of solutions supported by the Megaplex family and IPmux family. For more information about the TDMoIP concept, please refer to chapter 7.

Management options

Network management provides centralized control of all network nodes, including interface configuration, connection setup, alarms, and management.

Extensive network management is provided on multivendor management platforms using Megaplex with standard SNMP protocol. Megaplex provides the control and monitoring required in large networks using the RADview element manager platform. The Megaplex is also supported by RADview-SC/TDM and RADview-SC/TDMoIP, allowing the service allocation to be provided at the click of a mouse button.

All parameters are user-programmable for up to 10 independent configurations (10 databases per unit). All configurations are saved in non-volatile memory.

Alarm status and system configurations are available at all times. Multiple Megaplex hubs can be controlled from a single PC or UNIX workstation.

The Megaplex can be managed also via the RADview Service Center (for path management) or by third-party path management applications via CORBA interface. (For more details see page 202.)

Programming and setup of a remote Megaplex device is accomplished:

- Out-of-band, through the Ethernet port
- Out-of-band, through the supervisory port of the remote unit, over a modem link or FRAD
- Inband, using a dedicated timeslot, dedicated Frame Relay, PPP or TS0

Diagnostics

Megaplex incorporates test features for rapid fault detection and easy maintenance. Once in operation, all system and I/O modules undergo self-testing, and problems are reported to the management system. Local and remote loops may be performed on each channel and on the main links.

Any timeslot can be selected for BERT/tone injection. In addition, a loop can be initiated per any timeslot.

The ABCD status of any voice channel can be captured with a single click (signaling monitoring).

Megaplex-2100, Megaplex-2104
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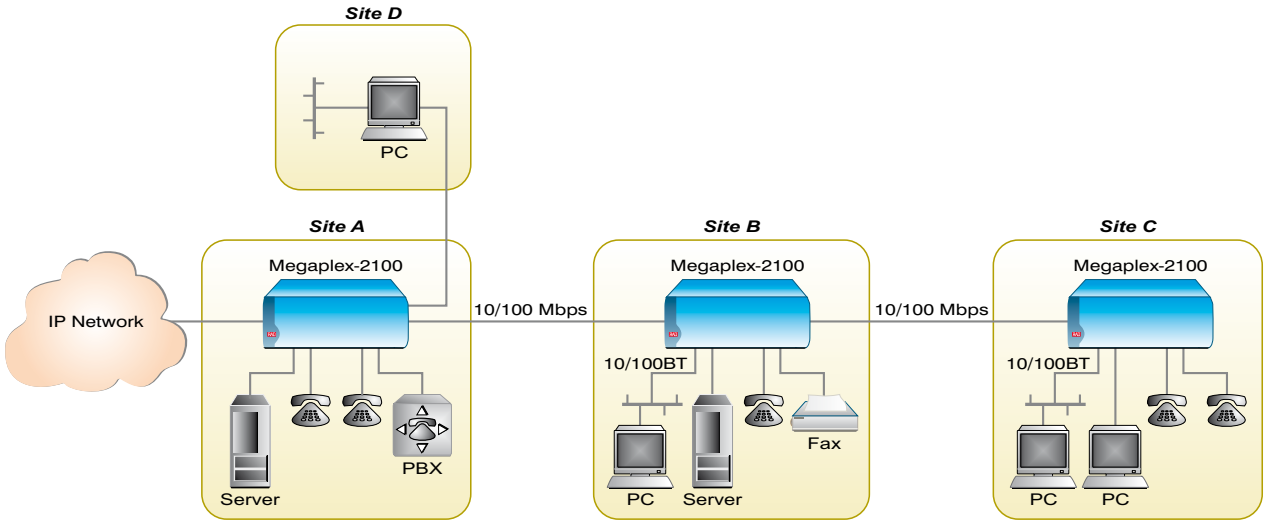


Megaplex-2100 Ethernet daisy chain

Alarms

Alarm information is stored in the common logic module and is automatically read by the management system from any node. Up to 256 alarms can be stored in a queue, and a maximum of 1,024 alarms can be stored in a file on the PC, to be read by the management system.

System modules

The common logic module stores configuration and event information, and uses a SLIP/PPP or Ethernet connection to communicate with the management station via an SNMP agent. Flash EPROM for remote software download, Telnet and an ASCII craft terminal are also supported.

Main link modules

The single or dual E1/T1 and ML-IP main link modules incorporate the DS0 matrix between the I/O channels and each of the E1/T1 trunks. The modules support 8 Mbps non-blocking cross connect for any DS0 coming from either the channels or from the trunks. Multiple fractional E1/T1 ports are supported. These main links support 1+1 protective switching for any E1/T1 port.

The eight E1/T1/DSL main links support a higher capacity of 16 Mbps when used together with the HS-12 module, but do not support redundancy.

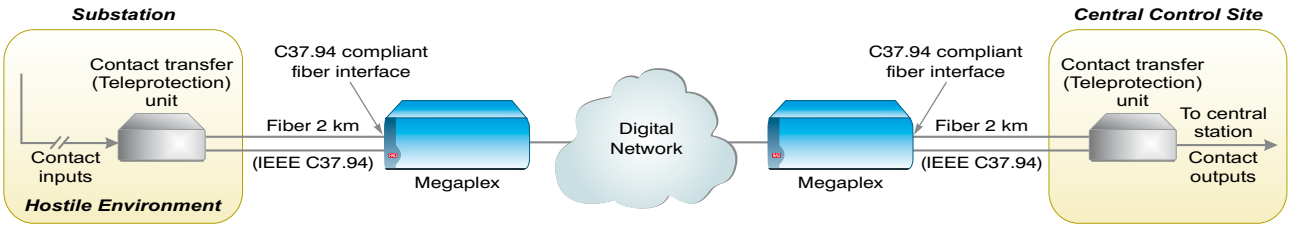
Four timing options are available:

- Link receive clock
- Internal crystal oscillator channel
- Clock from any high speed module (HS-6N, HS-12N, HS-S, HS-U, HS-703, HS-Q/N)
- Station clock

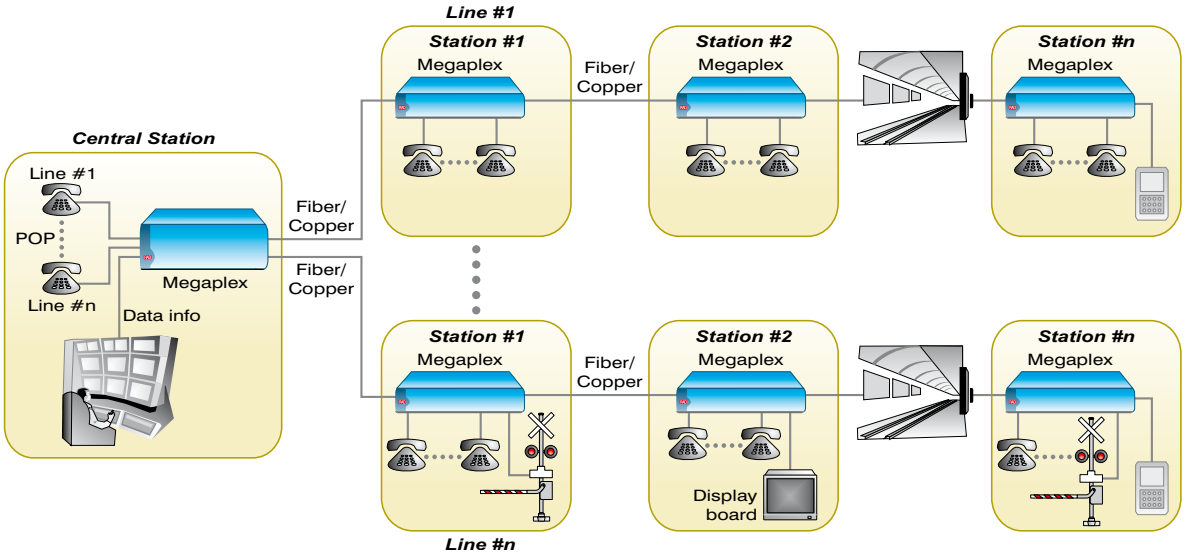
Any clock source can be set as the fallback in the event of primary clock source failure.

Ring support (E1/T1 and RFER)

The Megaplex supports various ring topologies ensuring "no single point of failure." E1/T1 ring protection provides self-healing in less than five seconds. Resilient Fast Ethernet Ring provides a 100 Mbps (up to 40 E1/50 T1) Ethernet ring with self-healing in less than 50 msec.



Teleprotection utility application



Party-line (Omnibus) dedicated voice application

Modular chassis

The Megaplex family consists of the 4U-high Megaplex-2100 with 12 slots and the 2U-high Megaplex-2104 chassis with five slots – for both I/O and main link modules. This allows for a mix of a wide variety of data, voice, fax, and LAN services. All Megaplex-2100 modules fit both Megaplex-2100 and Megaplex-2104 chassis.

Main link modules

ML-IP
Three-port 10/100BaseT Ethernet uplink module with up to 4 Mbps uplink capacity. This module serves as the main link to the IP network, placing the packetized TDM data stream from the I/O modules onto the IP network in the form of TDMoIP framing. The module is also available with two fiber optic 100BaseFX uplinks.

ML-2E1, ML-1E1, ML-2T1, ML-1T1
Dual/single E1/T1 links with integral, soft-configurable LTU/CSU.

MLF-2E1, MLF-1E1, MLF-2T1, MLF-1T1
Dual/single E1/T1 links with fiber interfaces, eliminating the need for an external fiber optic modem.

ML-20N
Dual/single n x 64 kbps main link with data interfaces such as V.35, X.21 and more.

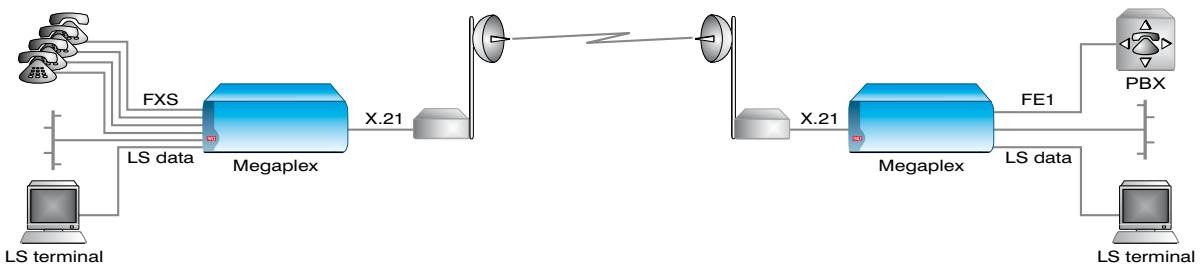
MSL-8
Eight-port SHDSL module, extending the range up to 10.6 km (3.5 miles) over existing copper lines.

ML-8E1, ML-8T1
Eight-port E1/T1 main link module

I/O modules

Data modules

HS-ETH/SW
Four 10/100BaseT LAN module with builtin Layer 2 Ethernet switch, featuring VLAN support and static routing capabilities.



Optimized services over narrowband link using ML-20N

Megaplex-2100, Megaplex-2104
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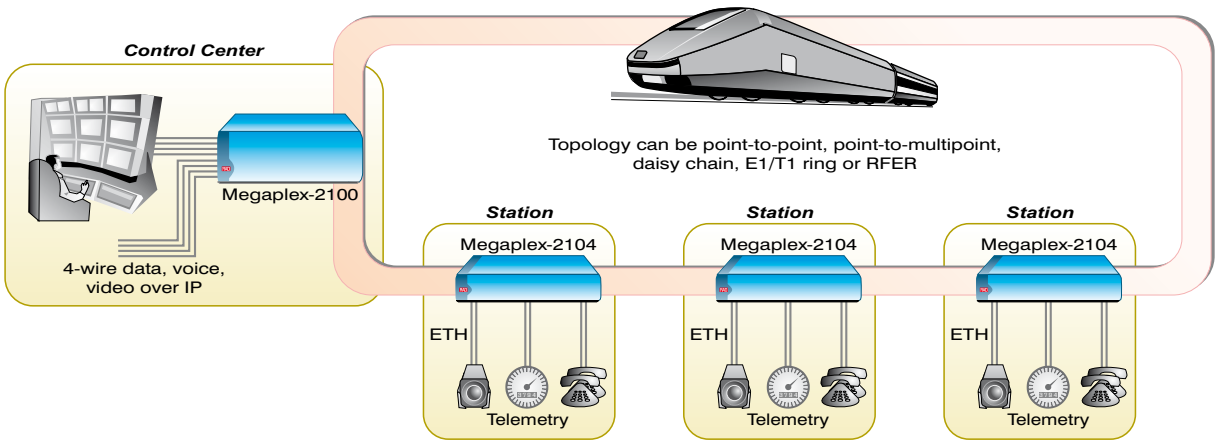
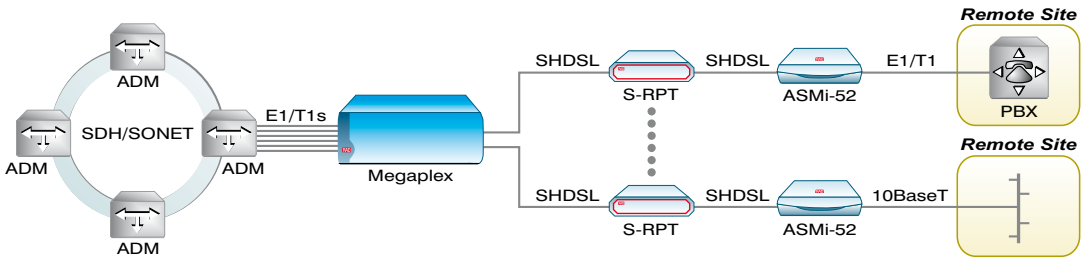


Multiple services for railway in a variety of topologies



SHDSL central site solution

HS-DP
OCUDP low speed module with three/six ports

HSF-1, HSF-2
n x 64 kbps fiber data module for transporting teleprotection signals, IEEE C37.94 compliant

HS-Q/N, HS-6N, HS-12N
Four, six, or 12 channels, each with independently selectable data rates of n x 64 kbps or n x 56 kbps (n = 1 to 31 for E1, or 1 to 24 for T1). Interface is field-selectable for V.35, V.36/V.11, X.21 or RS-530/RS-422.

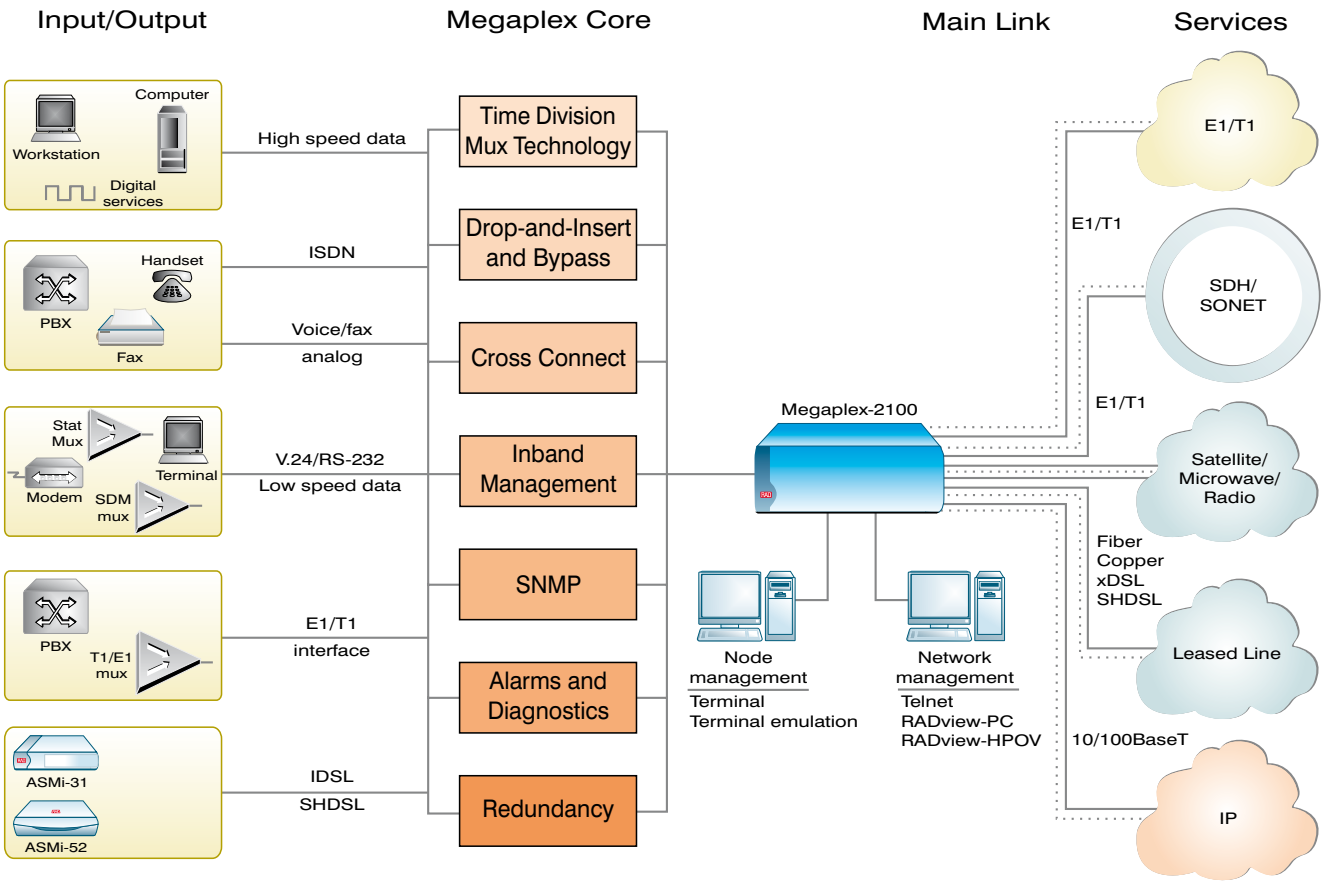
HS-703
Four 64 kbps G.703, codirectional channels

HS-RN
Four V.24/RS-232 low speed channels. Supports channel data rates up to 38.4 kbps async and up to 64 kbps sync, supporting end-to-end control signals.

LS-6N, LS-12
Six/twelve sync/async V.24/RS-232 channels with rates from 1.2 kbps baud to 64 kbps, and end-to-end control signal and BERT.

HS-U, HS-U-6, HS-U-12
Four, six or twelve U interface channels (2B+D) using 2B1Q line code for full duplex operation over 2-wire. Supports data rates up to 128 kbps and a range of up to 5 km (3.1 miles), and includes power feeding to the remote NT. Includes full duplex mode for management of remote ASMi-31.

HS-S, HS-S-12
Four or 12 ISDN S interface channels (2B+D). Operates as either TE or NT. Each channel supports data rates up to 128 kbps.



Voice/fax modules

VC-4, VC-8, VC-16
Four, eight or 16 PCM voice channels with optional E&M, FXS and FXO interfaces

VC-4A, VC-8A
Four or eight analog voice channels using PCM (64 kbps) encoding or ADPCM (24 or 32 kbps) encoding, with E&M, FXS or FXO interface options

VC-16A
Sixteen toll-quality, PCM/ADPCM (32/64 kbps) non-signaling voice compression channels, enabling two voice channels to be placed on each 64 kbps timeslot

VC-4/E&M/OMNI
A special Omnibus E&M interface module provides four toll-quality voice channels to support applications where a master site needs to communicate with multiple remote stations simultaneously (such as to broadcast an important message).

VC-6/LB, VC-6/4LB
Four or six voice channels for operation with special local battery (LB) telephone sets (e.g., military field telephones)

VFS-60/48/30/24
Voice compression module with up to 2 x E1 or 2 x T1 capacity, using G.723.1 (6.3 kbps per channel) or G.729.A (8.0 kbps per channel) compression methods, with modem/fax relay, transparent timeslot support, voice activity detection, silence suppression, and comfort noise generation. Voice compression server functionality enables compression of TDM traffic from the Megaplex backplane and compression of analog channels from voice modules.

Megaplex-104, Megaplex-204

Compact Voice Channel Banks

- **Cost-effective channel banks for small applications**
- **Plug-and-play**
- **PCM-encoded FXS analog voice channels**
  Megaplex-104: eight channels
  Megaplex-204: 16 channels
- **Single E1 uplink**
- **Soft Rx/Tx gain control**
- **PCM encoded, A-Law or µ-Law**
- **Each FXS port supports loop-start, soft gain level setting, polarity reversal, metering, enhanced line tests**
- **Enhanced diagnostics per channel**
- **Caller ID-enabled**
- **Support for Group III fax**

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The Megaplex-104 and Megaplex-204 are cost-effective channel banks designed specifically for small point-of-presence (POP) applications. They have one E1 uplink and can support up to eight or 16 FXS voice channels, respectively. The channels support various analog voice features which are required for voice services providers.

Each FXS port supports caller ID, loop-start signaling, reverse polarity, and 12 kHz/16 kHz metering pulse, thereby meeting the specifications for public payphones.

Inband fax support for Group III fax machines complies with T.4 and T.30.

Management options

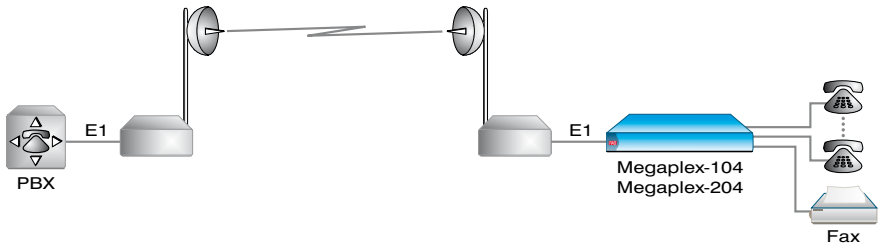
Management capabilities for the Megaplex-104 and Megaplex-204 include inband management and out-of-band management via an Ethernet port or via a terminal using the local serial port.

Plug-and-play

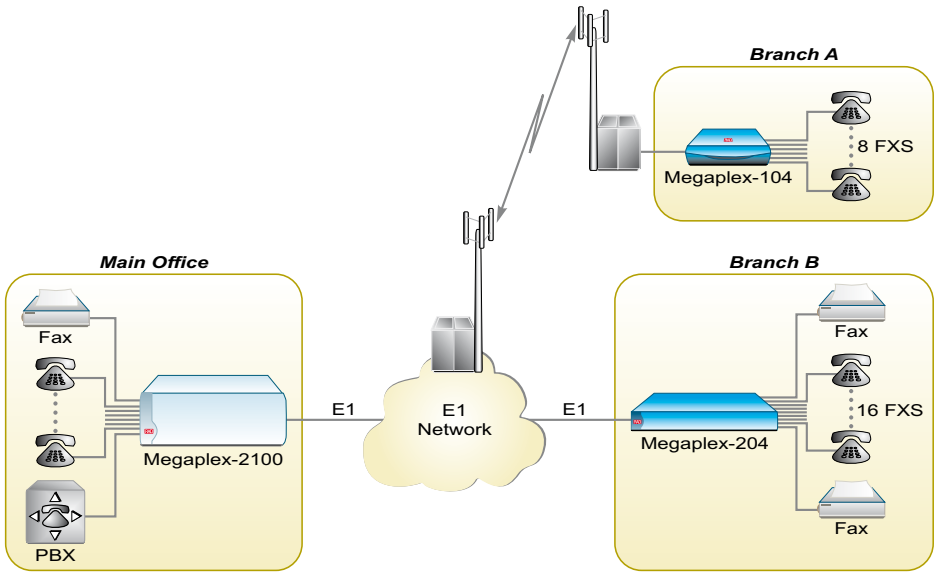
The Megaplex-104 and Megaplex-204 come with factory default settings to allow plug-and-play installation. They support both loopback timing (LBT mode) and a local, internal source clock (INT mode).

The Megaplex-104 is a compact, 1U-high unit, half 19-inch wide, suitable for the desktop, wall-mounting or mounting in a 19-inch rack (mounting kits available).

The Megaplex-204 is a 19-inch wide, 1U-high unit provided in a metal chassis.



Alternative voice provider application using wireless



Voice connectivity over E1 links

PRBm-20

Signaling Monitoring Probe

RAD's PRBm-20 probe is a cost-effective method for centralizing network management and reducing traffic monitoring costs. Rather than installing expensive analyzers at small and medium-sized locations or sending management information from each E1/T1 line over a separate link, the PRBm-20 concentrates up to 31 signaling timeslots and sends them to a central protocol analyzer over a fully utilized link.

Cuts OpEx for maintaining services

The PRBm-20 reduces the cost of ownership of advanced, revenue-generating services, such as SMS messaging, instant messaging, call forwarding, voicemail and international roaming, by collecting signaling timeslots from many leased lines and grooming them over a full link to the protocol analyzer at the central site.

Reduces leased line costs

The PRBm-20 extracts the signaling timeslots from up to eight links and grooms them onto one E1/T1 or fractional E1/T1 output line. By extracting any of the signaling timeslots from the traffic, the PRBm-20 reduces the number of lines required to connect to the protocol analyzer.

Improves network performance

Service providers use the data from the signaling timeslots to monitor the quality of the connection and to detect network faults. PRBm-20 cost-effectively transports signaling information, enabling the service provider to assure quality of service (QoS) at a competitive price.

Complementary solution

The PRBm-20 can be used to expand any existing monitoring method. It seamlessly integrates with any T-connector or patch panel used to divert the E1/T1 timeslots, and with any standards-based protocol analyzer. The PRBm-20 non-modular, standalone, E1/T1 probe is the latest low-end addition to RAD's signaling monitoring solutions. RAD offers a range of signaling monitoring devices, transporting signaling timeslots from links at speeds of up to STM-1 fiber optic links (see DXC family, pages 98-101).

- **Cost-effective signaling monitoring:**
  - **grooms the signaling information over a minimum number of links**
  - **reduces the required number of protocol analyzers**
- **Most compact solution on the market (half 19-inch, 1U-high chassis)**
- **Integrates with any existing signaling monitoring system**
- **Direct grooming of any timeslot**
- **Flexible – can extract different timeslots**
- **Wide variety of management options, from ASCII terminal to NMS**

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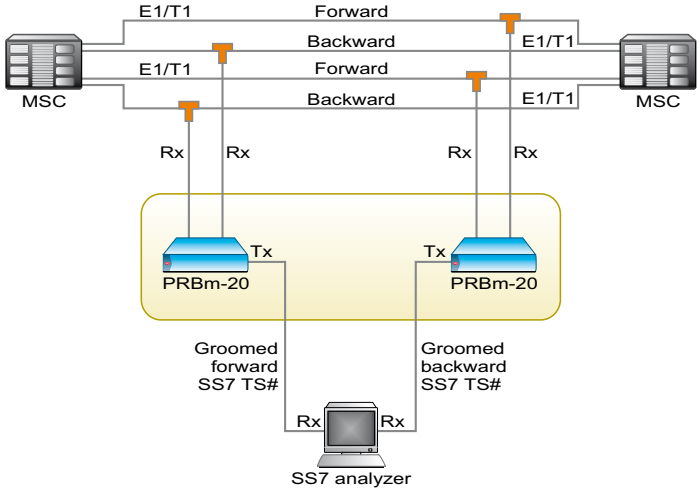

Signaling monitoring

DXC Family

Multiservice Access Nodes

- **DS0 non-blocking cross connect and groomer**
- **Broadcast capabilities (point-to-multipoint)**
- **Compact 1U or 3U-high enclosure**
- **Modular construction with four, five or 15 I/O slots**
- **Services supported: n x 56/64 kbps, ISDN, IDSL, SHDSL, E1, T1, E3, T3, and STM-1**
- **Optional system redundancy**
- **Optional link and/or hardware protection**
- **Integrated fiber optic, SHDSL and IDSL modems**
- **Built-in E1/T1 converter, including A-law/μ-law and signaling conversion for PCM timeslots**

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The DXC family consists of modular multiservice access nodes, providing non-blocking DS0 cross connect for up to 120 lines.

Plug-in interface modules can accommodate up to eight links each (see Modules section on page 100). Many services are supported, including n x 56/64 kbps, ISDN, E1, T1, E3, T3, and STM-1.

Cross connect, groomer and broadcast

All DXC modules allow maximum flexibility between ports. A user-programmable connection matrix connects any incoming 56/64 kbps timeslot to any outgoing 56/64 kbps timeslot. It supports cross connect functions, such as drop-and-insert, distribute and collect.

The DXC family enables the grooming of fractional traffic from the user side into full E1/T1, E3/T3 or STM-1 trunks, for connection to the network. Grooming and bandwidth maximization are implemented by placing the n x 56/64 kbps data channels into an E1 or T1 frame (including internal E1/T1 of the E3 or T3 modules or VC-12 containers of the STM-1 module), using only the required number of timeslots. This provides fractional CSU/DSU functionality.

The DXC family can broadcast any traffic combination from a single input to numerous destinations. Channel relocating and half duplex conferencing are also supported.

E1/T1 converter

The DXC family is also capable of converting between E1/T1 ports. A-law/μ-law and signaling conversion are performed according to E1 and T1 standards. DXC-8R, DXC-10A and DXC-30 convert up to 16 ports. T1 traffic can be directly extracted from the STM-1 module (which can act as a converter for up to 30 T1 links).

E3, T3 and STM-1 multiplexer modules

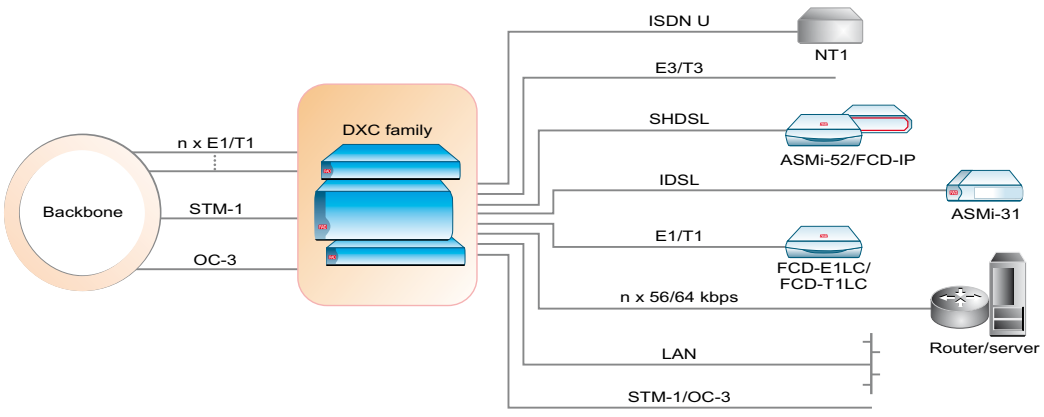
These modules provide full channelization functionality for the multiplexing and demultiplexing of DS0 traffic. Aggregated payload is 34 Mbps for E3; 45 Mbps for T3; and the equivalent of 61 Mbps for STM-1 (one chassis). When chaining a number of units, the aggregated payload is equivalent to 155 Mbps. G.747 is supported by DXC-100 (see page 102).

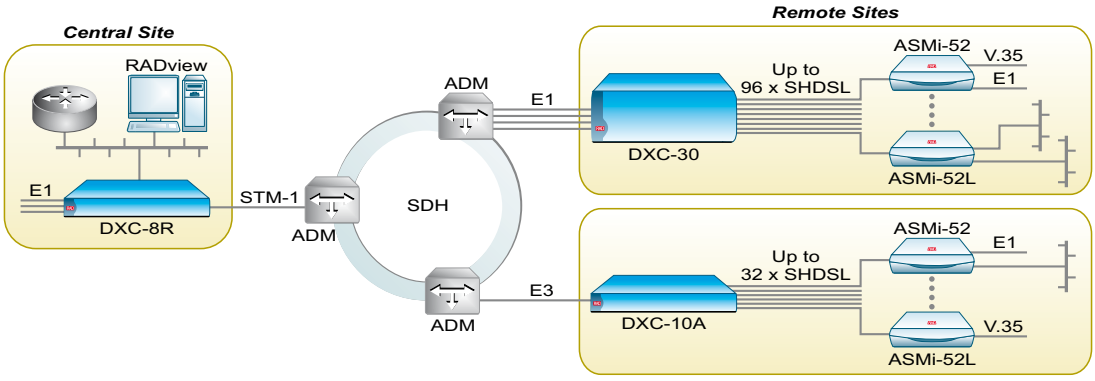
Redundancy

The DXC family provides flexible redundancy and protection to accommodate each user's needs and help minimize service downtime. The modules' link protection is user-programmable. Hardware protection and partial or full redundancy can be added at any time.

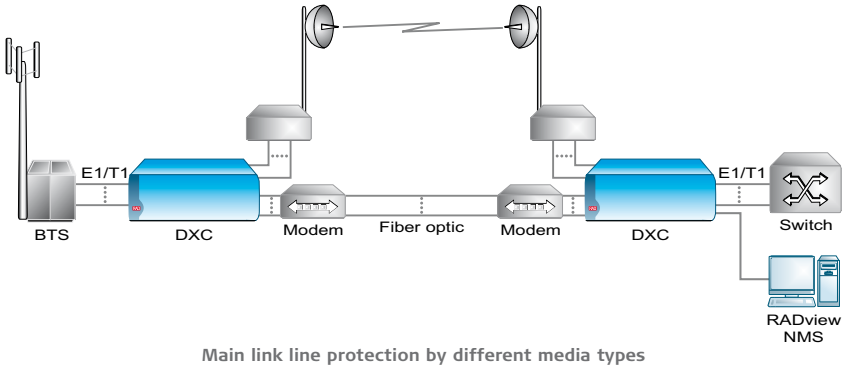
Redundancy in each unit:

- DXC-30 system redundancy (power supply and common logic) is optional and can be added at any time. Partial redundancy can also be provided.
- DXC-8R has built-in full system redundancy
- DXC-10A has no system redundancy
- Most DXC modules support line redundancy





Extending services over DSL



Main link line protection by different media types

Basic units

DXC-4

The compact half 19-inch, 1U-high unit grooms timeslots from four or eight E1/T1 links to a single E1/T1 uplink. Optional power supply redundancy (see page 104).

DXC-8R

The compact 1U-high unit can support up to 32 ports. It is fully redundant and includes two power supplies, two common logic modules and four I/O slots for the plug-in interface modules.

DXC-10A

The compact 1U-high unit can support up to 40 ports. It is not redundant and includes one power supply, one common logic module and five I/O slots for the plug-in interface modules.

DXC-30

The space-saving 3U-high unit can support up to 120 ports. The basic unit includes one power supply, one common logic module and 15 I/O slots for the plug-in interface modules. Optional secondary power supply and/or common logic can be ordered at any time for full or partial system redundancy.

DXC-100

The stackable unit can support up to 688 ports and 1.2 Gbps 3/1/0 cross connect capabilities (see page 102). Various timing options cover all timing possibilities for the E1/T1 interface. These include internal clock, external clock and loopback timing sourcing from any selected E1/T1, n x 56/64 kbps, E3/T3, or STM-1 port.

Setup, management and diagnostic tools

Setup, control and diagnostics can be performed via an ASCII terminal or Ethernet port. A built-in SNMP agent enables three management options:

- Independent management
- Management by the RADview-EMS/TDM network management system running on an HP OpenView or Windows platform
- Management by the RADview Service Center path management system

Configuration and diagnostics of remote services are provided through either TS0 or a dedicated timeslot, which can be groomed by the DXC alongside the payload traffic (for up to 30 management links supporting PPP). Out-of-band management is available via PPP or SLIP. Diagnostic loopback support for most modules includes loopback toward the local or remote DTE. Data monitoring capabilities are supported by configuring any high speed port to monitor any given port in the enclosure. The DXC can be controlled remotely via dial-up modem.

DXC Family
(Continued)

Modules

Most modules listed on this page are supported by all DXC chassis. A variety of port densities are available, from single-port to eight-port modules. Most modules support hardware and/or line redundancy and ensure a protective switching time of under 50 msec.

Additional features include integrated modems (fiber, IDSL and SHDSL), range extenders and powerful, integrated testing capabilities that minimize network downtime. The DXC features built-in BER testing, programmable on any port on a timeslot level, and loopback capabilities.

STM-1 terminal module

DFSTM-1 one-port or two-port standard 155 Mbps STM-1 interface provides direct access to the STM-n SDH ADM at the STM-n level. The STM-1 terminal multiplexer (TM) module grooms up to 61.44 Mbps of traffic to a standard STM-1 frame over fiber or copper. The two-port module can be used in a drop-and-insert daisy chain to expand services or for redundancy. When daisy-chaining units, full payload is supported.

E3/T3 modules

DE3 one-port E3 interface module provides access to a standard E3 frame over an unbalanced coax or fiber link. A user-programmable connection table enables fractional data traffic from various sources to be groomed into full internal E1 trunks.

DT3 one-port T3 interface module provides access to a standard T3 frame over an unbalanced T3 or fiber link. A user-programmable connection table enables fractional data traffic from various sources to be groomed into full internal T1 trunks.

E1 modules

D4E1/D8E1 four-port or eight-port interface modules transmit to a range of 2.2 km (1.4 miles) by using the built-in LTU. They have a data rate of up to 2.048 Mbps per port, and support BERT and loopback per timeslot. Resistive attenuation adjustment (10 dB – 30 dB) supports signaling monitoring applications (such as SS7 network maintenance and billing).

DE1B two-port E1 interface module transmits to a range of up to 2.2 km (1.4 miles) with an LTU option. BERT and loopback per timeslot are optional. Automatic traffic bypassing is optional.

T1 modules

D4T1/D8T1 four-port or eight-port interface modules transmit to a range of up to 2.2 km (1.4 miles) by using the built-in CSU. The data rate is up to 1.544 Mbps per port. The module supports BERT and loopback per timeslot. Attenuation adjustment (10 dB – 30 dB) supports signaling monitoring applications (such as SS7 network maintenance and billing).

DT1B two-port T1 interface module transmits to a range of up to 2.2 km (1.4 miles) with a CSU option. BERT, loopback per timeslot and automatic traffic bypassing are optional.

xDSL modules

D8SL eight-port interface module uses standard SHDSL technology to extend the range of E1 connections over 2-wire cable up to 10.7 km (6.6 miles)

D4SL four-port interface module uses standard SHDSL technology to extend the range of E1 connections over 2-wire cable up to 10.7 km (6.6 miles)

D8U eight-port module enables IDSL extension to remote modems at ranges up to 5.5 km (3.4 miles) or as ISDN (U interface) 2B+D channel transmission at ranges up to 5.5 km (3.4 miles). Data rate is up to 128 kbps per port.

Special modules

D8HS eight-port n x 56/64 kbps data module provides eight high speed synchronous data channels, independently selected for V.35, RS-422/V.11, X.21 or RS-530 interface.

DHS two-port n x 56/64 kbps data module provides two high speed synchronous data channels. Each channel is independently selected for 10/100BaseT Ethernet bridge, including VLAN support, 10BaseT Ethernet router, V.35, RS-422/V.11, X.21, or RS-530 interface.

Features	DXC-8R	DXC-10A	DXC-30
Height	1U	1U	3U
Maximum number of ports	32	40	120
Number of I/O slots	4	5	15
System redundancy	Built-in	None	Optional
E1, T1, E3, T3, STM-1 modules supported	All	All	All
ISDN, ISDL, SHDSL modules supported	All	All	All
n x 56/64 kbps	All	All	All
ASCII, SNMP, RADview NMS management supported	All	All	All

Applications

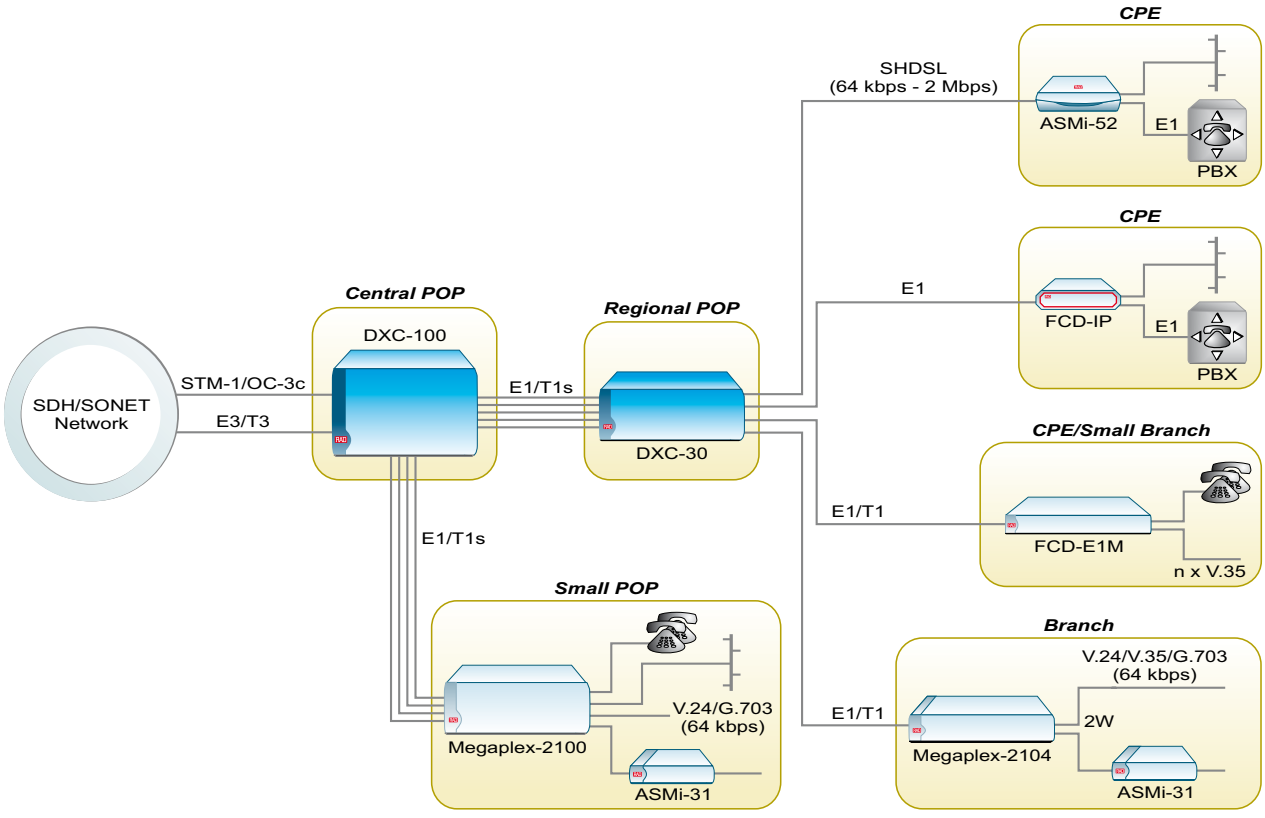
The DXC family acts as the central solution for many RAD or other standards-based products. The DXC-8R and DXC-10A 1U chassis are geared for installations that require a compact unit (e.g., cellular base stations) or lower capacity of up to 40 ports (e.g., a carrier's initial stage of deployment). Typical applications:

- E1/T1 access platform over SHDSL, IDSL, fiber, or copper, featuring data/voice concentration and integrated management
- Providing conversion/gateway between T1 and E1 networks, for both data and voice
- Providing high speed access (e.g., Ethernet, HSSI) to a carrier's high speed digital backbone over n x E1/T1, E3/T3 or STM-1, where n represents one to eight lines
- Splitting data and voice traffic
- Distributing services from an SDH or other network to a wide variety of end users by creating an E1/T1 or STM-1 daisy chain
- Grooming fractional trunks to full trunks
- Maximizing data traffic payload over E3, T3 or STM-1 trunks
- Grooming of monitoring signals (SS7 or other) for advanced services and quality of service
- Broadcasting identical data to multiple destinations
- Cross connecting trunks at the point-of presence (POP)
- Grooming a variety of services at the POP over n x E1/T1, E3/T3 or STM-1

Target markets

DXC users and markets include the following:

- Cellular operators
- Wireless operators
- Incumbent and alternative carriers
- International carriers
- Utility companies
- Enterprises
- Multi-tenant units (MTUs)
- Transportation
- Ship-to-shore communications
- Test and maintenance operators (SS7 networks)
- Internet service providers (ISPs)



Grooming lower data rate traffic into higher data rate trunks

DXC-100

Multiservice Access Node

- **Carrier-class 4/3/1/0 non-blocking cross connect**
- **256 Mbps to 1.2 Gbps matrix**
- **Expandable (stackable) 6U-high unit**
- **Modular construction with 11 to 86 I/O slots**
- **Services supported: n x 56/64 kbps, E1, T1, E3, T3 (including G.747), OC-3, STM-1, and channelized router**
- **Built-in E1/T1 conversion, including A-law/μ-law and signaling conversion on E1/T1, E3/T3 and STM-1/OC-3 interfaces**
- **Supports up to 640 n x 56/64 kbps, 688 E1/T1, 80 E3/T3, 32 STM-1/OC-3 as well as 80 channelized router ports**
- **Service redundancy 1:n and 1:1 with optional protection switch (3U-high unit) or on main unit for STM-1 or OC-3 modules**
- **Optional 1:1 system redundancy**

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DXC-100 is a scalable multiservice access node that enables the incremental deployment of voice and data networks. As the networks grow, up to eight DXC-100 units can be stacked to provide very high density grooming, concentration and cross connect.

Scalable platform with minimal initial investment

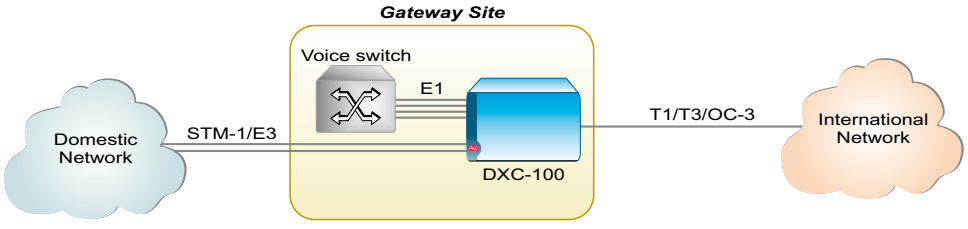
The modular, 6U-high DXC-100 is the newest member of the DXC family of multiservice access nodes. Each high density chassis supports 80 n x 56/64 kbps, 88 E1, 88 T1, 11 E3, 11 T3, four STM-1, or four OC-3 links. Up to eight chassis can be stacked to support up to 640 n x 56/64 kbps, 688 E1, 688 T1, 80 E3, 80 T3, 32 STM-1, or eight OC-3 lines, for a powerful, central site solution. (See the system capacity table on page 103 for more details.) The scalable platform enables a carrier to deploy a low cost system that meets its current requirements and add more ports as its customer base grows.

Manages bandwidth for diverse voice and data applications

DXC-100 satisfies a wide range of broadband and narrowband applications for carriers, cellular operators, ISPs, utility companies, and enterprises. Applications include E1/T1 conversion, high speed access to a carrier's backbone, grooming fractional trunks into full trunks, maximizing data traffic payload over E3, T3, STM-1 or OC-3 trunks, grooming data traffic from different locations into a channelized Ethernet router, and grooming monitoring signals for quality of service or advanced services. It optimizes the SS7 network by consolidating n x 56/64 kbps and E1/T1 functionality in a single, cost-effective, managed device. The DXC-100 can also aggregate Ethernet traffic from several remote sites via different trunks (for example, ISP or corporate traffic) into one stream by using the channelized router module. Operating as a digital cross connect, the DXC-100 provides 4/3/1/0 non-blocking switching that is comparable to larger, more costly systems.

Protects investment in legacy networks

The DXC-100 can connect copper-based edge devices and networks to a fiber-based core, and performs port concentration and grooming for protocol-based platforms. Therefore, the DXC-100 provides a migration path to optical and packet switched networks. The channelized router enables grooming traffic, saving the cost of additional equipment or ports.



International gateway

Management and redundancy capabilities

Redundant system and services modules, together with protection switching, ensure dependable operation of the product. The RADview SNMP central network management system enables remote configuration and diagnostics, reducing operating expenses, eliminating costly technician visits, and maximizing network performance and uptime. The DXC-100 unit at the central site can use the inband management feature to manage remote RAD multiservice access platform (MAP) products.

Modules

DSTM-1 SDH STM-1 module supports up to 63 VC-12 (E1) or 84 VC-11 (T1) embedded links with optional 1:1 redundancy. 155 Mbps long range 1310 nm single mode fiber.

DOC-3 SONET OC-3 module supports up to 84 VT1.5 (T1) embedded links with optional 1:1 redundancy. 155 Mbps long range 1310 nm single mode fiber.

DE3 supports single E3 link containing 16 embedded E1s plus integral BERT and loopback diagnostics. Optional 1:n redundancy.

DT3 supports single T3 link (containing a mix of up to 28 T1s or 21 E1s per ITU G.747) with M13 or C-bit framing, BZ3S encoding plus integral BERT and loopback diagnostics. Optional 1:n redundancy.

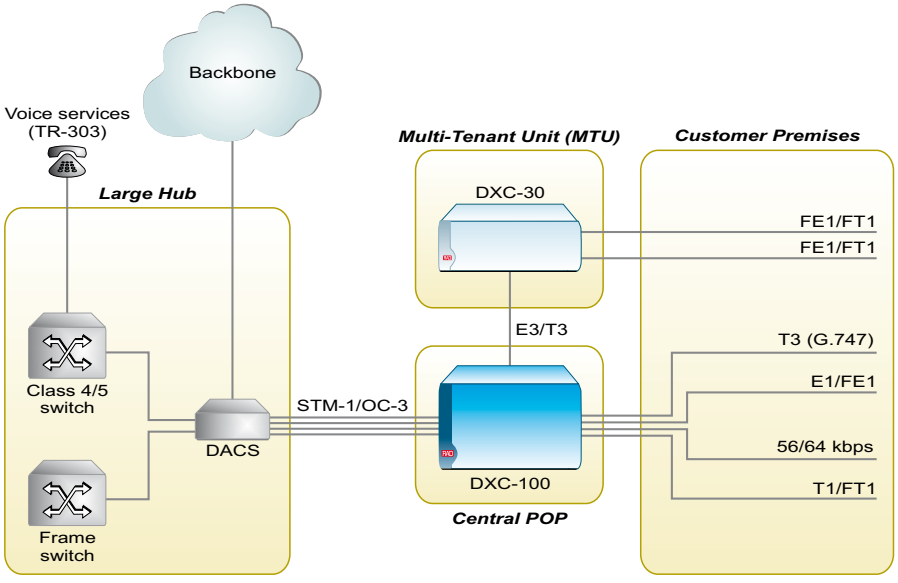
D8E1T1 supports eight T1 (100 ohm) or E1 (120 ohm) balanced interfaces in any combination. D4, ESF or G.70x framing and AMI, B8ZS or HDB3 line coding plus integral BERT and loopback diagnostics. E1/T1 voice encoding and signaling bit conversion included. Optional 1:n redundancy.

DROUTER supports up to 32 individual channels (one to 32 timeslots) and up to 2 Mbps for IP/IPX routing including RIP, RIP-2 and OSPF, plus additional features such as network address translation (NAT). Integral SNMP agent is provided along with external contact closure detection and notification. Supports 10/100BaseT LAN hub functionality. Detects status of up to three external contact closures.

D8HS supports eight synchronous DCE ports operating at n x 56/64 kbps data rates with a maximum speed of 2.048 Mbps plus control signal selection and integral BERT and loopback diagnostics. Eight individual RS-232, RS-422/449, RS-530, RS-530A, V.35 or X.21/27 interfaces in any combination can be supported.

System capacity

Ports	DXC-100 1 unit	DXC-100 8 units (stacked)
n x 56/64 kbps	88	640
E1	88	688
T1	88	688
E3	11	80
T3	11	80
STM-1	4	32
OC-3	4	32
Router	10	80



Central DACS

DXC-4

Fractional E1/T1 Groomer

- **Grooms fractional links onto one E1/T1 link**
- **Four or eight E1/T1 ports**
- **Simple installation and operation**
- **Compact, half 19-inch solution**
- **SNMP management**

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The DXC-4 fractional E1/T1 groomer offers reliable E1/T1 grooming of TDM traffic for up to eight fractional E1/T1 lines onto a single E1/T1 link, saving costs on leased lines and offering quick payback.

Cost-effective grooming for mobile operators

The DXC-4 fractional E1/T1 groomer offers a cost-effective solution for backhauling of TDM traffic from base stations (BTS) to cellular networks. The compact, standalone DXC-4 is widely deployed by cellular, wireless and leased line operators to optimize bandwidth utilization or to maximize services by separating and redirecting TDM traffic according to type.

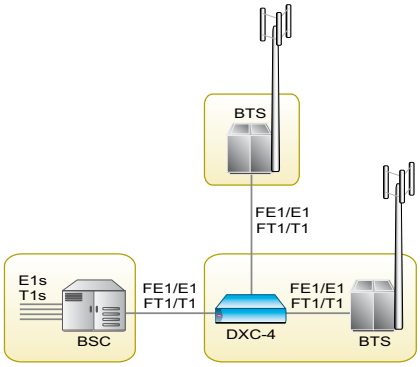
Alternatively the DXC-4 E1/T1 groomer can groom DS0 timeslots including the signal information into a single E1/T1 link. The DXC-4 E1/T1 grooming solution complements RAD's DXC family of cross connects and can also be deployed on any E1/T1 device.

Four or eight ports

The scalable DXC-4 can be ordered with four or eight ports to support four or eight link channels. The DXC-4 E1/T1 grooming device supports user-selectable E1 or T1 links. Internal LTU/CSU is included. The DXC-4 is ETSI-rack installation ready.

The DXC-4 E1/T1 grooming solution has an SNMP agent. A wide range of management options such as ASCII terminal, Telnet and RADview are available via two NMS ports.

The DXC-4 is a compact half 19-inch non-modular solution. The DXC-4 E1/T1 grooming solution has an optional redundant power supply.



DXC-2

E1/T1 Converter and Timeslot Cross Connect

- **Converts between E1 and T1 data and signaling**
- **Configurable A-law/μ-law and signaling conversion; or transparent conversion at 64 kbps timeslot level**
- **Controlled slip for buffer overflow/ underflow**
- **Soft-selectable to comply with ITU Rec. G.802, Annex 2**
- **Optionally available with built-in LTU (E1) or CSU (T1)**

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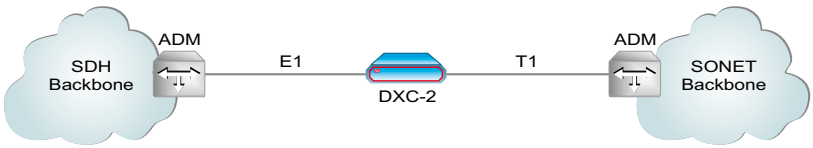

The DXC-2 E1/T1 converter and timeslot cross connect enables conversion between one E1 signal and one T1 signal (24 timeslots). For applications requiring timeslot swapping between two devices operating at the same speed, the unit can also be ordered with two ports of the same type (i.e., two E1 or two T1 ports). An optional built-in LTU (E1) or CSU (T1) is available on either port.

A user-programmable connection table defines the connection of any 64 kbps incoming timeslot to any outgoing timeslot. The DXC-2 can also perform the required A-law/μ-law and signaling conversion in compliance with E1 and T1 standards. The E1-to-T1 conversion method can be soft-selected to comply with ITU G.802.

Diagnostic loopback support for E1/T1 interfaces includes loopback towards the local or remote DTE.

Several clock modes cover all timing possibilities for the E1/T1 interface. These include internal clock and loopback timing for either the E1 or T1 interface.

The E1 interface complies with ITU G.703, G.704, G.732, and G.823, and supports both two and 16 frames per multiframe with or without CRC-4. Line code is HDB3.

The T1 interface complies with AT&T TR-62411 and ANSI T1.403 requirements, and supports both D4 or ESF framing formats and AMI line code. Zero suppression is selectable between transparent transmission, B7ZS or B8ZS.

Setup, control and diagnostics can be performed via the front panel or an ASCII terminal.

FCD-E1M, FCD-T1M

Modular E1/T1 or Fractional E1/T1 Access Units Supporting Megaplex-2100 Modules

The FCD-E1M and FCD-T1M are dedicated access multiplexers for business customers, providing integration of voice and data traffic over full E1/T1 or fractional E1/T1 links. They can also be used as integrating multiplexers.

The devices have a single n x 56/64 kbps data port and an I/O module slot supporting one Megaplex I/O module (HS-Q/N, HS-S, or HS-U) to provide four high or low speed data channels, and four ISDN S or U interfaces. Alternatively, the built-in data port can be replaced by an Ethernet bridge/router port. The FCD-E1M and FCD-T1M also offer an optional sub-E1/T1 drop-and-insert port for PBX connectivity.

The FCD-E1M can be ordered with an internal LTU (line termination unit), allowing direct connection to the E1 network, or can connect via an external LTU. The FCD-T1M has an integral CSU, for direct connection to the T1 network. Optionally, either unit can support a fiber optic main link interface for multimode or single mode fiber, eliminating the need for an external fiber optic modem.

Operates with DXC access node

The FCD-E1M and FCD-T1M can operate with RAD's modular DXC multiservice access node products in multilink star applications for access to SDH/SONET networks. The DXC and FCD units operate under a centralized SNMP network management.

Flexible timeslot assignment

Timeslot assignment is programmable, allowing data from the data port and from the sub-E1/T1 link to be placed into timeslots consecutively. FCD-E1M and FCD-T1M also provide additional flexibility by giving full user control over the data port timeslot allocation.

Multiple clock source selection ensures maximum flexibility for supporting different applications. The main E1/T1 link may be clocked from the recovered receive clock, an internal oscillator, one of the data ports, or the sub-E1/T1 link.

Immunity to hardware and power failures is provided by bypassing the sub-E1/T1 port to the main E1/T1 link, ensuring uninterrupted service to the sub-E1/T1 port.

The E1 interface meets all requirements of ITU recommendations G.703, G.704, G.706, and G.732. It supports both two and 16 frames per multiframe, with or without CRC-4. Zero suppression over the line is HDB3. The integral LTU ensures a range of up to 2 km (1.2 miles).

The T1 interface meets all requirements of TR-62411 and TR-62421. It supports both D4 and ESF frame formats. Zero suppression over the line is selectable for either transparent, B7ZS or B8ZS. The integral CSU ensures a range of up to 1.6 km (1 mile).

Management options

Setup, control and monitoring of status and diagnostics can be performed via an ASCII terminal. The FCD-E1M and FCD-T1M can also be managed via any standard SNMP application or the RADview SNMP network management application. Inband management is available via TS0 (E1) or datalink bit (T1), or a dedicated timeslot using standard Frame Relay (RFC 1490), PPP and RIP-2 routing protocols.

The units support dial-in/dial-out, which can also be used for remote out-of-band configuration and monitoring, via serial V.24, SLIP, PPP, or Ethernet ports.

Enhanced diagnostics include user-activated local and remote loopbacks, an integrated BER tester and fractional E1/T1 inband loops.

The FCD-E1M and FCD-T1M are 19-inch, 1U-high, standalone units for desktop use. A rack-mount adapter kit enables installation in a 19-inch rack.

- **One data port with selectable sync data rates: n x 56 kbps, n x 64 kbps**
- **Single slot supports the following Megaplex modules: HS-Q/N, HS-S or HS-U**
- **Optional sub-E1/T1 drop-and-insert port for PBX connectivity**
- **Fail-safe sub-E1/T1 ensures uninterrupted service**
- **Operates with RAD's DXC multiservice access node for multilink star configuration**
- **Main link available with optional integral LTU/CSU or optional fiber optic modem**
- **Data interfaces: V.35, RS-530, V.36/RS-449 or X.21**
- **Integrated Ethernet bridge/router option**
- **24-hour performance monitoring storage**

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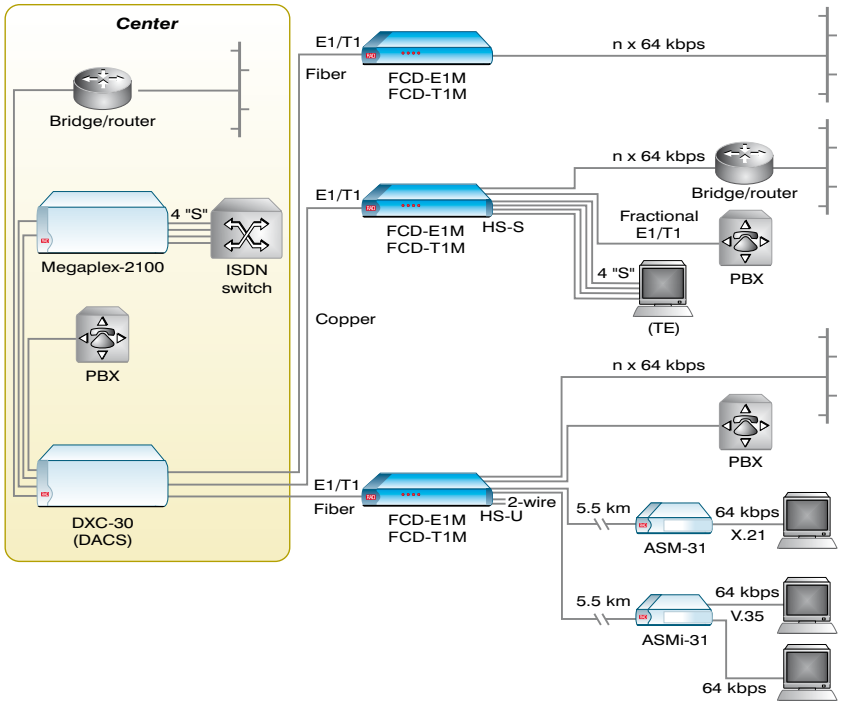

FCD-E1L, FCD-T1L, FCD-E1LC, FCD-T1LC

E1/T1 or Fractional E1/T1 Managed Access Units

- **Single or dual port access to E1/T1 or fractional E1/T1 services**
- **SNMP agent**
- **Out-of-band management via V.24 supervisory port**
- **Selectable sync data rates, n x 64 kbps or unframed E1/T1**
- **Data interfaces: V.35, RS-530, V.36/RS-449, X.21, V.24**
- **Integrated Ethernet bridge, 10/100BaseT VLAN bridge or 10BaseT router options**
- **E1 interface complies with ITU G.703, G.704, G.706, G.732, G.823**
- **Main link diagnostics include loopbacks and BERT**

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The FCD-E1L and FCD-E1LC are managed single or dual port access units for full or fractional E1 services, ideal for use as managed interface converters. Data port rates are selectable for any multiple of 64 kbps up to 1,984 kbps. Alternatively, unframed E1 can be supported up to 2.048 Mbps.

The FCD-T1L and FCD-T1LC are designed for T1-based environments, providing data rates from 56/64 kbps up to 1,536 kbps. Unframed T1 is supported up to 1,544 kbps.

Optional Ethernet port

The basic unit is available with a single data port and an optional second data port. In the FCD-E1L/FCD-T1L the second data port can be replaced by an Ethernet bridge, 10/100 VLAN bridge or 10BaseT router for direct connection to the LAN. The FCD-E1LC and FCD-T1LC have sub-E1/T1 drop-and-insert ports for PBX connectivity.

User data is placed into the E1/T1 frame using only the required number of timeslots. Timeslot assignment is performed according to the data port speed and can be consecutive or random, starting from any timeslot.

Plug-and-play

For ease of installation, the FCD-E1L and FCD-T1L offer plug-and-play connectivity. Upon connection to the E1/T1 link, the unit automatically detects the E1/T1 parameters and autoconfigures. Manual configuration is an option.

The FCD-E1L and FCD-E1LC are available with an integral LTU (line termination unit) to provide a range of up to 2 km (1.2 miles). The FCD-T1L and FCD-T1LC include a built-in CSU, for direct connection to the T1 network and providing a range of up to 2 km (1.2 miles).

Standards compliant

The FCD-E1L and FCD-E1LC meet all requirements of ITU G.703, G.704, G.706, G.732, and G.823. They support both two and 16 frames per multiframe, with or without CRC-4. Zero suppression over the line is HDB3.

The FCD-T1L and FCD-T1LC comply with TR 62411 and TR 62421 and support both D4 and ESF frame formats. Zero suppression over the line is selectable for either B7ZS or B8ZS transparent.

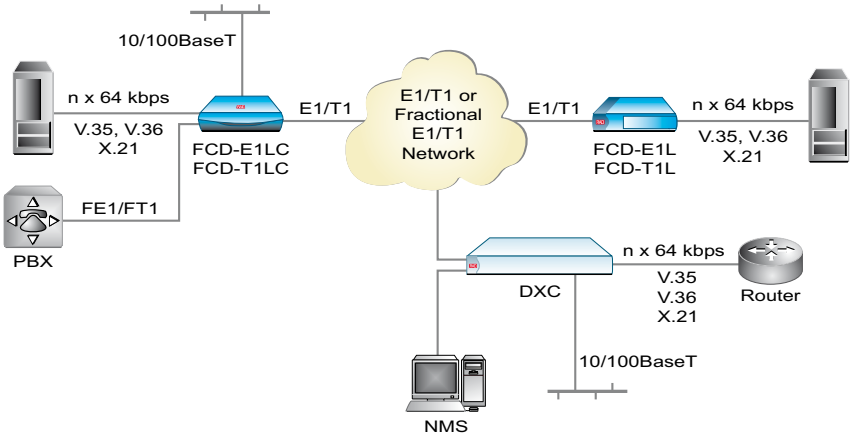
Clock recovery, management, diagnostics

The units may be clocked from the recovered receive clock of the main/sub-E1/T1 link or from an internal oscillator. The data channel interface is RS-530. Adapter cables are available for V.35, V.36/RS-422 or X.21.

All models support an internal SNMP agent and can be managed by any generic SNMP station or by the RADview SNMP network management application. The units support dial-in/dial-out, which can be used for remote out-of-band configuration and monitoring (dial-in) and for alarms (dial-out).

Diagnostics include user-activated local loopbacks on the main/sub-E1/T1 link and DCE data port. A pseudo-random data pattern (BERT) can be used to check the transmission path as well as the local and remote units.

All models are available as standalone units for the desktop or a 19-inch rack shelf.



FCD-E1, FCD-T1, FCD-E1A

E1/T1 or Fractional E1/T1 Access Units

The FCD-E1 and FCD-T1 are access units for full or fractional E1/T1 services. Available with either one or two data ports and an optional sub-E1/T1 drop-and-insert port, data port rates are selectable for any multiple of 56 kbps or 64 kbps, up to 1,984 kbps. Alternatively, one of the data ports can be replaced by an Ethernet bridge, providing direct connection to the LAN. In the FCD-E1A, one of the data ports can also be replaced by four S0 interfaces for ISDN BRI extension, or by an ISDN backup interface.

Internal or external line termination unit

The FCD-E1 is available with or without an internal LTU (line termination unit), allowing direct connection to the E1 network or connection via an external LTU. In the FCD-E1A this capability is built-in and can be configured with or without LTU by the customer. The FCD-T1 has a built-in CSU, allowing direct connection to the T1 network.

Interoperability with the DXC multiservice access node

The FCD-E1, FCD-T1 and FCD-E1A can operate with RAD's modular DXC multiservice access node products for multilink star applications, including access to SDH/SONET networks.

Programmable timeslot allocation

Timeslot assignment is programmable, allowing data from each data port and from the sub-E1/T1 port to be placed into timeslots on the main link, either consecutively or alternately.

Multiple clock source selection ensures maximum flexibility, enabling the support of different applications.

Immunity to hardware and power failures is provided by bypassing the sub-E1/T1 port to the main E1/T1 link, ensuring uninterrupted service to the sub-E1/T1 port.

Standards compliant

The FCD-E1 and FCD-E1A comply with ITU recommendations G.703, G.704, G.706, and G.732. It supports both two and 16 frames per multiframe, with or without CRC-4. Zero suppression over the line is HDB3. The integral LTU ensures a range of up to 2 km (1.2 miles).

The FCD-T1 meets all TR-62411 and TR-62421 requirements. It supports both D4 and ESF frame formats. Zero suppression over the line is selectable for either transparent, B7ZS or B8ZS. The integral CSU ensures a range of up to 1.6 km (1 mile).

Setup, control and monitoring

Setup, control and monitoring of status and diagnostic information can be activated via:

- Front panel LCD with pushbuttons (menu-driven management)
- ASCII terminal connected to the async control port (command line interpreter)
- SNMP management connected to the async control port
- Inband management through a datalink bit (T1), a dedicated timeslot or TS0 (E1), supporting proprietary protocol and Frame Relay RFC 1490

Network management

The products support an internal SNMP agent and can be controlled by any generic SNMP station or by the RADview-HPOV or RADview-PC (FCD-E1A only) SNMP network management application.

The units support dial-in/dial-out, which can be used for remote out-of-band configuration and monitoring (dial-in) and for alarms (dial-out).

Maintenance capabilities include user-activated local and remote loopbacks and internal BERTs on the main E1/T1 link, sub-E1/T1 link and data ports. The FCD-T1 also responds to network-activated loops (RLB, LLB) when CSU-configured.

The products are standalone units for the desktop or a 19-inch rack shelf.

- **One or two data ports**
- **Selectable sync data rates: n x 56 kbps, n x 64 kbps**
- **Data interfaces: V.35, RS-530, V.36/RS-449, X.21 or four S0 (FCD-E1A only)**
- **Integrated Ethernet bridge/router option**
- **Optional sub-E1/T1 drop-and-insert port for PBX connectivity**
- **Fail-safe sub-E1/T1 ensuring uninterrupted service**
- **Operates with RAD's DXC multiservice access node for multilink star configuration**
- **Main link available with optional integral LTU/CSU or with fiber optic modem**
- **Optional ISDN backup for data (FCD-E1A only)**
- **24-hour performance monitoring storage**

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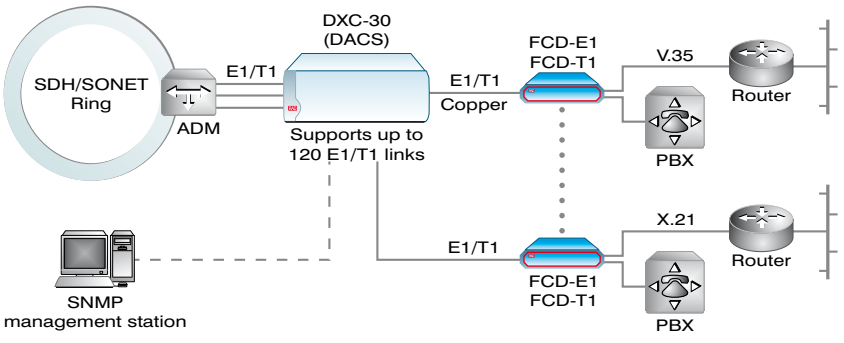

SDH/SONET access solution for multiple sites

FCD-IPM

E1/T1 or Fractional E1/T1 Modular Access Device with Integrated Router

- **Modular integrated access device (IAD) for providing bundled services (telephony and Internet access) over E1/T1 lines**
- **E1/T1 access over copper (E1 only) or fiber**
- **One or two independent Ethernet ports**
- **Optional integrated four-port switch**
- **Support for Frame Relay (RFC 1490) and PPP protocols**
- **OSPF support**
- **Data interfaces: V.35, RS-530, V.36/RS-449, V.24, X.21**
- **Fail-safe sub-E1/T1 port ensures uninterrupted service**
- **Supports up to 12 analog voice channels (FXS, FXO, E&M)**
- **Optional dial-up or integrated ISDN backup**

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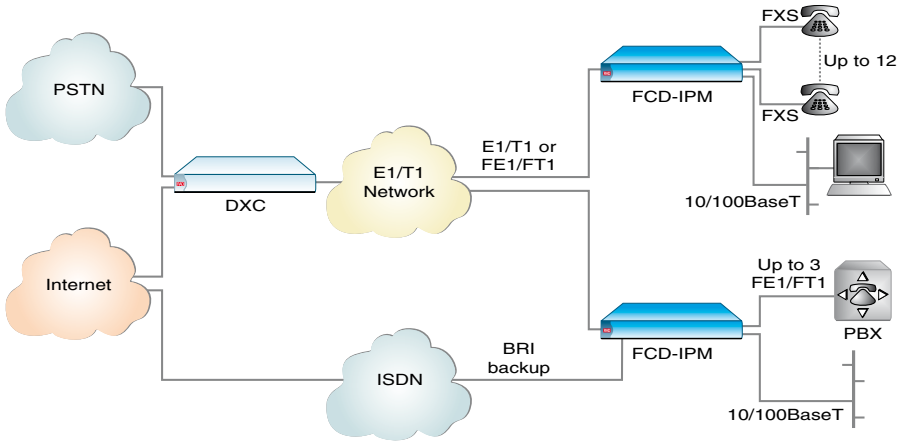

The FCD-IPM is an E1/T1 or fractional E1/T1 modular integrated access device (IAD) with a built-in router.

The FCD-IPM enables service providers to bundle data and voice services together with Internet access over a single E1 or T1 line.

The modular design enables carriers to adopt and comply with changing customer needs.
The modules include:

- Four or eight analog voice ports
- One or two fractional E1/T1 ports
- Universal data port
- Four-port hub/switch module

The FCD-IPM is available with a software-selectable internal line termination unit (LTU), which allows direct connection to the E1 network or connection via an external LTU. A built-in CSU/DSU allows direct connection to a T1 network.

The integrated router supports:

- IP and IPX routing and transparent bridging
- Backup router link capability
- Quick setup and configuration
- Solid Firewall™ (session-based) protection
- NAT and Single IP address translation
- PAP/CHAP security
- OSPF

The FCD-IPM can also be used as a rate and interface converter or as an integrating multiplexer for fractional E1/T1 analog voice and data services.

Interoperability with DXC multiservice access node

The FCD-IPM can operate with RAD's modular DXC multiservice access node products for multilink star applications, including access to SDH networks. The DXC units and FCD-IPM operate under a centralized SNMP network management.

Timeslot assignment is programmable, allowing data from the LAN, sub-E1/T1 port, analog voice ports, and data port to be placed into timeslots, either consecutively or alternately. The FCD-IPM also allows flexible timeslot allocation of the data port timeslots. Each timeslot of the sub-E1/T1 port is placed on the same timeslot of the main E1/T1 link.

Data from the data port can be either assigned transparently to the main link timeslots or routed together with the LAN data.

Immunity to hardware and power failures is provided by bypassing the sub-E1/T1 port to the main E1/T1 link, ensuring uninterrupted service to the sub-E1/T1 port.

The E1 interface meets all requirements of ITU recommendations G.703, G.704, G.706, and G.732.

The T1 interface is compatible with virtually all carrier-provided T1 services.

Management options

Setup, control and monitoring of status and diagnostic information can be performed via:

- ASCII terminal connected to the async control port
- SNMP management
- Inband management through a dedicated timeslot

The FCD-IPM supports dial-in, which can be used for remote out-of-band configuration and monitoring.

Maintenance capabilities include user-activated local and remote loopbacks.

The FCD-IPM is available as a standalone unit for the desktop or a 19-inch rack shelf.

FCD-IPL

E1 and Fractional E1 Access Unit with Integrated IP Router

The FCD-IPL is a customer-located demarcation router for transporting 10/100BaseT Ethernet traffic over E1 or fractional E1 links. It is ideal for supporting large-scale rollouts of Layer 3 VPN services over E1 lines to small and medium-sized enterprises (SMEs).

The FCD-IPL comes with an integrated IP router supporting PPP. The internal IP router operates in two modes: standard IP routing based on static entries, RIP-1 and RIP-2; and transparent IP, in which frames received via the LAN/WAN interface are routed to the other interface, with the exception of management traffic, which is sent to the FCD-IPL host IP address.

QoS differentiation for VoIP, video and data

The FCD-IPL transports Ethernet traffic at wire speed, enabling full use of the 2 Mbps link. The IEEE 802.3-compliant 10/100BaseT user port supports auto-negotiation and operates in both full and half duplex modes. Quality of service (QoS) is assured, based on standard class of service definitions according to IP Precedence (ToS) or DSCP. The user traffic is assigned to five distinct priority queues: one strict priority queue for VoIP and video applications and four weighted fair queues (WFQs) for data. The strict priority queue traffic is forwarded to the WAN link before traffic from any WFQ, minimizing delay and maintaining the quality of the transmission.

Powerful network availability and management features

FCD-IPL features a unique bidirectional fault propagation mechanism that constantly monitors the status of the network and user connections. If a failure is detected on one of the interfaces, the FCD-IPL automatically shuts down the other port.

The FCD-IPL can be managed inband via Telnet, Web-based applications and SNMP or out-of-band via a direct connection to an ASCII terminal.

- **IP router supports PPP WAN over E1 or fractional E1 links**
- **Supports E1 uplink and 10/100BaseT Ethernet user port**
- **Standard and transparent IP routing**
- **QoS for user traffic prioritization**
- **Bidirectional fault propagation**
- **Powerful SNMP, Telnet and control port management capabilities:**
  - **in-band and out-of-band access**
  - **remote software download**
  - **statistics collection**

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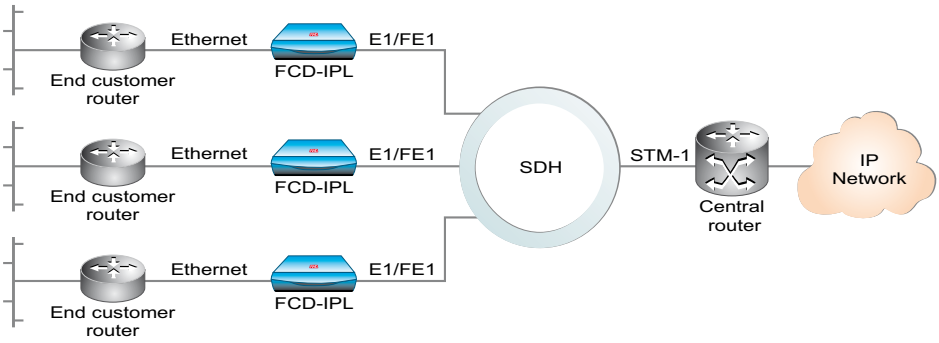

Intelligent demarcation for access to Layer 3 IP VPN services

FCD-IPD

Dual E1 Router

- **Dual E1 router specially adapted for out-of-band ADM management over SDH or IP chain applications**
- **Single 10/100BaseT LAN interface or an integrated four-port switch**
- **Enables shared E1/fractional E1 bandwidth over SDH or other E1 rings**
- **Supports spanning tree protocol**
- **Proprietary routing protocol supports up to 100 hops**
- **IP routing**
- **Supports Frame Relay and PPP**
- **DHCP server**
- **Quick setup and configuration**
- **Inband and out-of-band remote management**
- **SNMP and Telnet support**
- **Dual management authorization levels (carrier/user)**

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The FCD-IPD is a dual E1 main link router, enabling shared E1 bandwidth over SDH or other E1 rings. The FCD-IPD is especially suited for management applications in SDH environments. In these applications, the FCD-IPD can manage up to 100 ADMs of different manufacturers over a single shared E1 or fractional E1 link, dynamically allocating up to 2 Mbps bandwidth to each node for high speed management.

The FCD-IPD supports alternative routing in the event of physical ring failure. It utilizes a specially developed proprietary routing protocol that can support up to 100 hops.

Ring topology capability

When configured as a bridge, FCD-IPD can function in a ring topology, implementing the spanning tree protocol.

Supported WAN services are:

- Dual E1 main links, with or without LTU, operating at up to 2.048 Mbps
- Frame Relay with auto-learn of DLCI and maintenance protocol

The integrated router supports:

- IP routing and transparent bridging
- Backup router link capability
- Quick setup and configuration

The E1 interface meets all ITU requirements: ITU G.703, G.704, G.706, and G.732.

Flexible management options

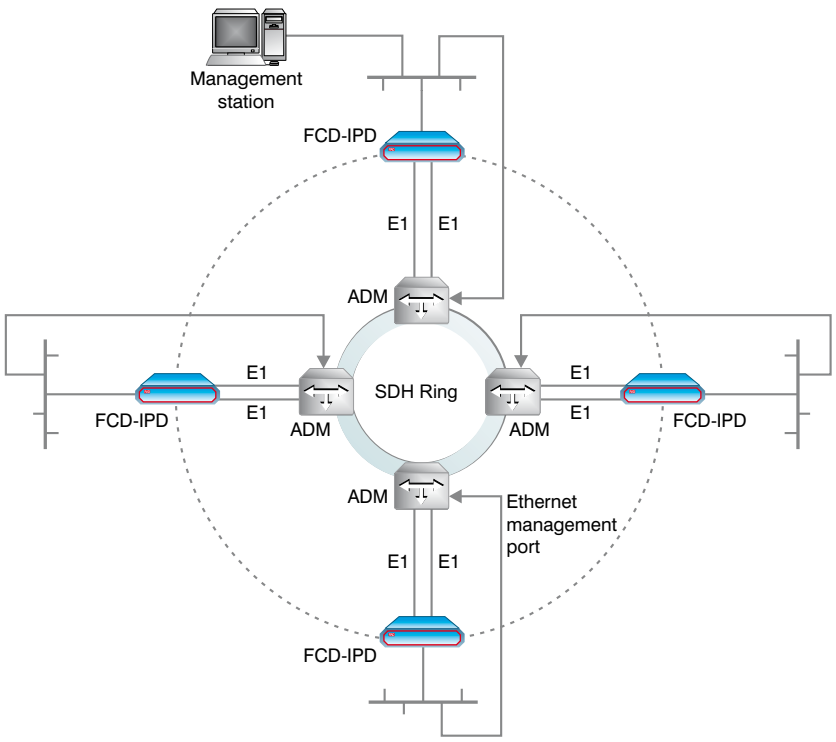
Setup, control, status monitoring, and diagnostics can be performed via:

- ASCII terminal connected to the async control port
- SNMP management
- Telnet

The FCD-IPD supports an internal SNMP agent and can be controlled by any generic SNMP station or by the RADview SNMP network management application.

Maintenance capabilities include user-activated local and remote loopbacks.

The FCD-IPD is available as a standalone unit for the desktop or a 19-inch rack shelf.



SDH network management via IP ring

FCD-IP

E1/T1 or Fractional E1/T1 Access Unit with Integrated Router

The FCD-IP is an access unit for full or fractional E1/T1 services with an integrated router. It can be ordered with one or two independent Ethernet LAN ports or alternatively with an integrated four-port switch that can replace an external hub or switch. An optional data port, sub-E1/T1 drop-and-insert port or four analog ports (FXS, FXO, E&M) are also available. The data port rates are selectable for any multiple of 56 kbps or 64 kbps, up to 1,984 kbps.

The FCD-IP is available with a software selectable internal LTU, and allows direct connection to the E1 network or connection via an external LTU. A built-in CSU/DSU allows direct connection to a T1 network.

Integrated router

The integrated router supports:

- IP/IPX routing and transparent bridging
- Backup router link capability
- Quick setup and configuration
- Solid Firewall™ (session-based) protection
- NAT and Single IP address translation
- PAP/CHAP security
- OSPF, RIP-1, RIP-2

The FCD-IP can also be used as an integrating multiplexer for LAN, data and fractional E1/T1 services.

The FCD-IP operates with RAD's modular DXC multiservice access node products for multilink star applications, including access to SDH networks. The DXC and FCD-IP units operate under centralized SNMP network management.

Timeslot assignment is programmable, allowing data from the LAN, sub-E1/T1, analog voice, and data ports to be placed into timeslots, either consecutively or alternately. The FCD-IP also allows flexible allocation of the data port timeslots. Each timeslot of the sub-E1/T1 port is placed on the same timeslot of the main E1/T1 link.

Ring and drop-and-insert capabilities

FCD-IP provides up to four fractional E1 links with automatic bypass in case of link failure.

This unit can be deployed in ring and daisy-chain applications together with the Megaplex multiplexers, to affordably connect smaller sites to the E1 ring, while offering the same self-healing link protection capabilities as the larger devices.

The E1 unit meets all requirements of ITU recommendations G.703, G.704, G.706 and G.732.

The T1 interface is compatible with virtually all carrier-provided T1 services.

Management and maintenance

Setup, control and monitoring of status and diagnostic information can be done using:

- ASCII terminal connected to control port
- Telnet
- SNMP management
- Inband management via dedicated timeslot

The FCD-IP supports an internal SNMP agent and can be controlled by any generic SNMP station or by the RADview SNMP network management application.

The FCD-IP supports dial-in, which can be used for remote out-of-band configuration and monitoring.

Maintenance capabilities include user-activated local and remote loopbacks.

The FCD-IP is available as a standalone unit for the desktop or a 19-inch rack shelf.

- **E1/T1 access over copper or fiber**
- **One or two independent Ethernet ports or an integrated four-port switch (10/100BaseT)**
- **IP/IPX routing and transparent bridging**
- **Supports Frame Relay (RFC 1490) and PPP protocols**
- **OSPF support**
- **Data interfaces: V.35, RS-530, V.36/RS-449, V.24, X.21**
- **Selectable sync data rates: n x 56 kbps, n x 64 kbps**
- **Three optional sub-E1/T1 ports or four analog ports (FXS, FXO, E&M) for PBX/ phone connectivity**
- **Self-healing ring and drop-and-insert capabilities**
- **Fail-safe sub-E1/T1 ensures uninterrupted service**
- **Dial backup over ISDN/PSTN**
- **Operates with RAD's DXC multiservice access node for multilink star configuration**

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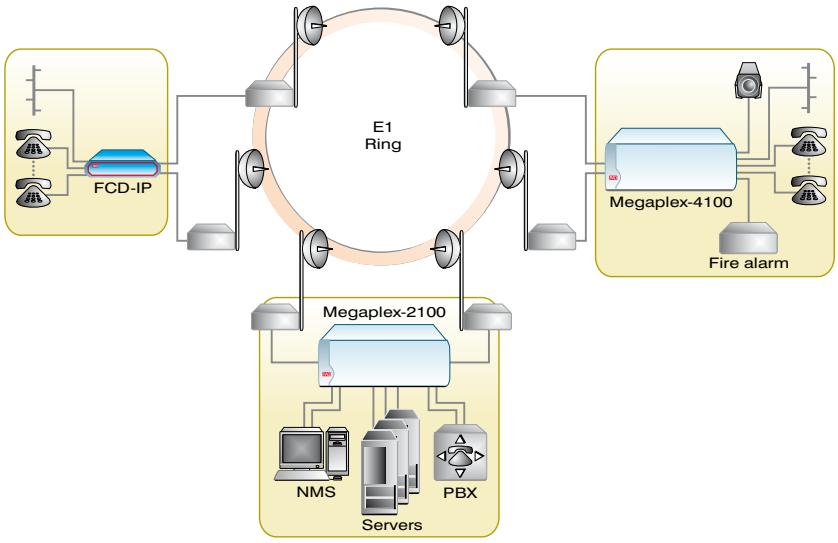

FCD-2L

E1 or Fractional E1 Access Unit

- **Single port access to E1 or fractional E1 services**
- **Optional built-in LTU**
- **Selectable sync data rates: n x 56 kbps, n x 64 kbps**
- **Data interfaces: V.35, RS-530, V.36/RS-422, X.21**
- **Integrated Ethernet bridge option**
- **E1 interface complies with ITU G.703, G.704, G.706, G.732, and G.823**
- **Main link diagnostics include loopbacks, BER test and data port monitoring**
- **DTE2 support**

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The FCD-2L is a single port access unit for full or fractional E1 services. Data port rates are selectable for any multiple of 56 kbps or 64 kbps up to 1,984 kbps. Alternatively, the data port can be replaced by an Ethernet bridge, providing direct connection to the LAN. User data is placed into the E1 frame, using only the required number of timeslots. Timeslot assignment is according to the data port speed and is consecutive, starting from any timeslot.

The FCD-2L can be ordered with or without an LTU (line termination unit). The integral LTU ensures a range of up to 2 km (1.2 miles).

The FCD-2L meets all requirements of ITU for G.703, G.704, G.706, G.732 and G.823. It supports both two and 16 frames per multiframe, with or without CRC-4. Zero suppression over the line is HDB3.

The unit may be clocked from the recovered receive clock (LBT) of the main E1 link or from an internal oscillator.

The data channel interface is RS-530. Adapter cables are available for V.35, V.36/RS-422 or X.21.

The unit also supports an optional UTP bridge port.

FCD-2L setup and control is by internal jumpers. Front panel switches control all diagnostic options.

Diagnostics include user-activated local loopbacks on the main E1 link and DCE data port. A pseudo-random data pattern (BERT) can be used to check the transmission path and the local and remote units. The FCD-2L can display major and minor alarms, and indicate bit error rate on the E1 line in excess of 1×10^{-3}.

The FCD-2L is available as a standalone unit or as a card for a 19-inch rack. An adapter kit enables installation of one or two standalone units in a 19-inch rack.

FCD-24

Integrating E1 Multiplexer

- **Integrates high speed data and an E1 link into E1 or fractional E1 services**
- **Two or four data channels**
- **Data interfaces: V.35, RS-530/V.36 or X.21**
- **Selectable data rates: n x 64 kbps**
- **Setup and control via front panel or supervisory port**
- **Complies with ITU G.703, G.704 and G.732**
- **Dial-out on alarm events**

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The FCD-24 is an integrating multiplexer for full and fractional E1 services. Two or four synchronous data channels and one E1 sub-link can be connected over the public E1 network. The E1 sub-link enables connection of user-defined timeslots from a PBX link to the main E1 interface.

The FCD-24 interface connections are modular, supporting two or four channels with or without an E1 sub-link.

Data rates are selectable for any multiple of 64 kbps. Selectable timeslot allocation places data into timeslots either consecutively or user-defined, without restriction.

Channel interface is V.35, RS-530 or X.21. An interface for V.36/RS-422 is also available using an adapter cable.

The FCD-24 is compatible with virtually all carrier-provided E1 services, meeting all requirements of ITU recommendations G.703, G.704 and G.732. It supports both two and 16 frames per multiframe. Zero suppression over the line is HDB3. An optional integral LTU (line termination unit) supports a range of up to 2 km (1.2 miles).

Flexible clock source selection on the main link and data channels allows support for most applications.

Setup, control and monitoring of status and diagnostic information can be activated via the front panel or via a terminal or PC, or remotely via dial-up modems.

Maintenance capabilities include local and remote loopbacks, as well as a built-in BER tester.

For dial-out operation, the FCD-24 automatically dials a pre-programmed number whenever an alarm event occurs.

FCD-E1E

Managed E1 and Fractional E1 Access Unit

The FCD-E1E is a multiplexer and rate and interface converter for point-to-point extension of serial data, Ethernet and E1 services or fractional E1 over SDH/SONET networks.

Offering a wide range of serial interfaces (V.35, V.36, RS-530, X.21) with selectable sync data rates of n x 64 kpbs, data port rates are selectable for any multiple of 64 kbps up to 1,984 kbps. Unframed E1 can be supported up to 2.048 Mbps.

The integral LTU ensures a range of up to 2 km (1.2 miles) and is software selectable.

The unit can be programmed to assign data automatically from the data port into consecutive timeslots or the user can assign timeslots manually.

Multiple clock source selection

Multiple clock source selection ensures maximum flexibility. Timing for the E1 main link and sublink may come from the recovered receive clock, an internal oscillator or the data port.

The unit interconnects with RAD's modular DXC products and E1 equipment from other vendors, to support multilink star applications, such as access to SDH networks, FCD and Megaplex units.

Ethernet extension

The FCD-E1E's Ethernet interface allows LAN-to-LAN connectivity over TDM.

The product's 10/100BaseT interface supports VLAN frames, auto-negotiation and automatic learning and aging. It transparently connects FCD-E1E to remote LANs over E1 links. It filters Ethernet frames and forwards only frames that are destined for the WAN.

FCD-E1E supports VLAN tagging and priority labeling according to 802.1p&q. Enhanced QoS supports strict/weighted fair queue mechanism, with 802.1p/DSCP/IP Precedence priority.

Standards compliant

The E1 interface is compatible with carrier-provided E1 services. The product complies with ITU recommendations G.703, G.704, G.706, G.732, G.823, and G.826.

Management

The FCE-E1E features an LCD front panel for menu-driven management using three pushbuttons.

Front panel LEDs indicate power, alarms and diagnostic loopback operation. Rear panel LEDs on the E1 interfaces indicate local and remote sync loss.

Status and diagnostic information is defined, configured, and monitored using any of the following methods:

- Menu-driven management using the front panel LCD with three pushbuttons
- ASCII terminal connected to the async control port
- Telnet
- RADView element manager

FCD-E1E is a compact standalone unit. A rack mount adapter kit enables installation of one or two (side-by-side) units in a 19-inch rack.

- **Serial, E1 and Ethernet multiplexer**
- **Rate and interface converter for serial access to E1 services**
- **One serial data port (V.35, V.36, RS-530, X.21) with selectable sync data rates of n x 64 kpbs**
- **Optional sub-E1 drop-and-insert port, including bypass support**
- **Optional 10/100BaseT Ethernet bridge**
- **Optional VLAN support**
- **User-friendly LCD panel with pushbuttons for management**
- **Inband management with SNMP agent**

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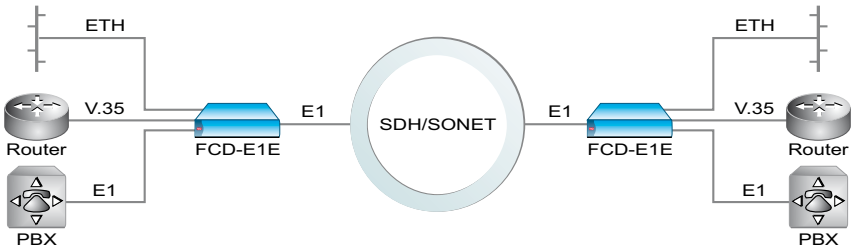


Point-to-point Ethernet, data and fractional E1 over E1

Optimux-108, Optimux-106

Four E1 or T1 and Ethernet or Data over Fiber Multiplexers

- **Optimux-108 multiplexer for E1 channels and Ethernet or data (V.35) over a single link**
- **Optimux-106 multiplexer for T1 channels and Ethernet over a single link**
- **Optional redundant wide range power supply**
- **Multimode or single mode fiber**
- **Single mode over single fiber or WDM**
- **Range up to 120 km (74.5 miles)**
- **Optional secondary hot-swappable link provides automatic backup**
- **Management via an ASCII terminal, Web terminal or SNMP**
- **Card version for the LRS-102 modem rack or the Megaplex-4100**

For latest updates visit www.rad.com

The Optimux-108 multiplexer transports four E1 channels and optional Ethernet or high speed data traffic over a fiber optic link. The Optimux-106 transports four T1 links and optional Ethernet traffic over a fiber optic link.

A pair of Optimux-108 or Optimux-106 units offers easy low cost connectivity for distances up to 120 km (74.5 miles).

Redundancy options

An optional secondary link provides backup using automatic switchover upon link failure, and an optional secondary power supply provides power redundancy and fail-safe operation.

The Optimux transmits each of the E1 or T1 signals independently, so that the clock of each E1 or T1 channel works independently from the clock of other E1 or T1 channels. The E1 interface can be 75 Ω unbalanced or 120 Ω balanced. The T1 interface is 100 Ω balanced.

Various optical interfaces are available:

- 850 nm VCSEL for use with multimode fiber
- 1310 nm for use with multimode fiber
- 1310 nm or 1550 nm short or long haul laser for extended range over single mode fiber
- Single mode over fiber option

Central site solutions

For central site solutions, the product can be supplied in card form for deployment in a modem rack or a multiservice access node.

The LRS-102 modem rack can work opposite and manage 24 Optimux-108 or Optimux-106 units (see page 153, LRS-102). This provides fully transparent transmission of all types of voice and data traffic, with an option to set each channel to a different clock source. As an additional feature for mixed environments, the LRS-102 provides a one-box solution for transmitting over copper modem, including SHDSL.bis, alongside fiber.

A card version can also be provided for deployment in the Megaplex-4100 next-generation multiservice access node. When installed in the Megaplex-4100, the product offers an aggregation and cross connect solution of E1/T1 and Ethernet traffic over SDH/SONET, IP or any other interface (see page 86).

Management options

For all product options, configuration, monitoring and maintenance operations can be performed via a supervisory port, using either an ASCII terminal, Telnet host, Web terminal or an SNMP management station. This is done via a dedicated Ethernet port in the Optimux-108 and Optimux-106.

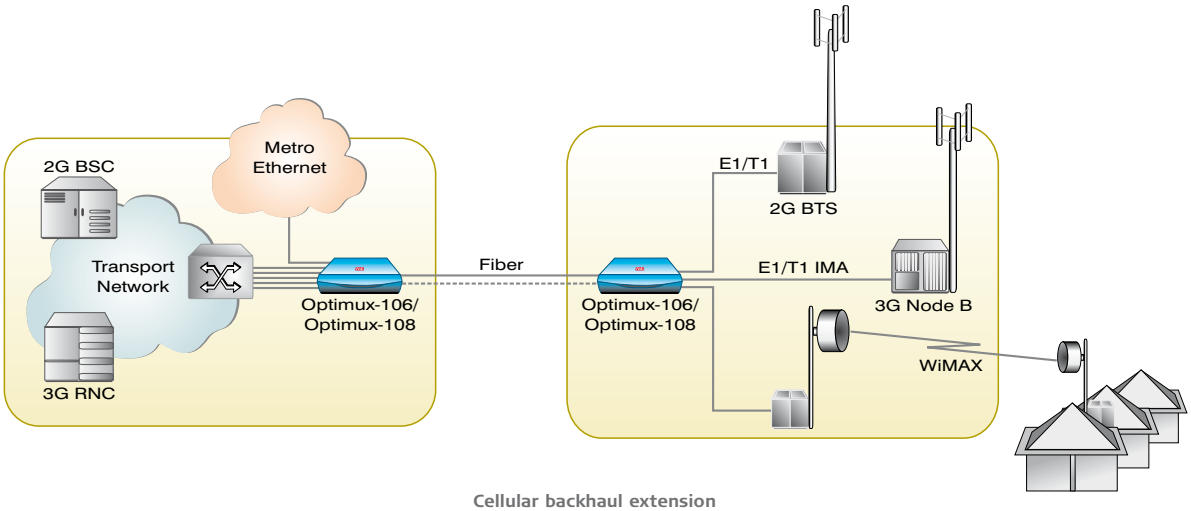
The SNMP management supports:

- RADview for PC
- RADview for HP OpenView UNIX platforms

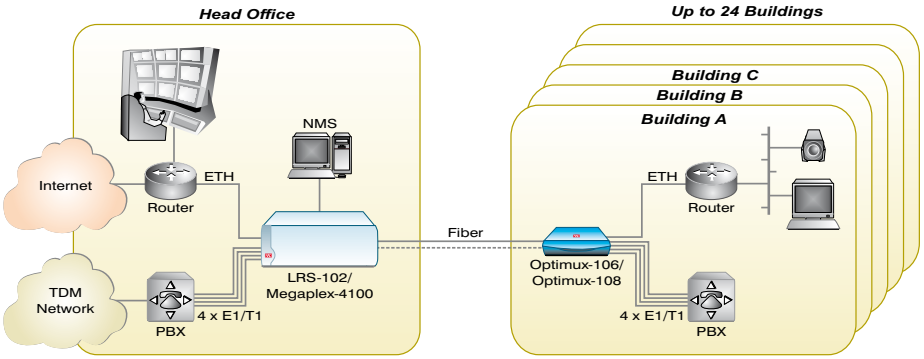
Standards compliance

The products conform with ITU G.703, G.742, G.823, G.829, G.955, and IEEE 802.3. To facilitate system diagnostics, the Optimux devices feature LED status indicators, AIS alarm generation, and recognition, and dry contact closure upon link failure.

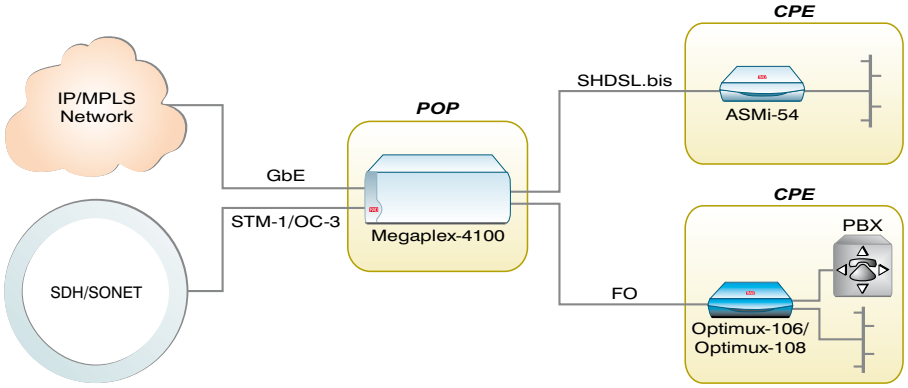
The standalone units are supplied in a compact, half 19-inch 1U-high enclosure.



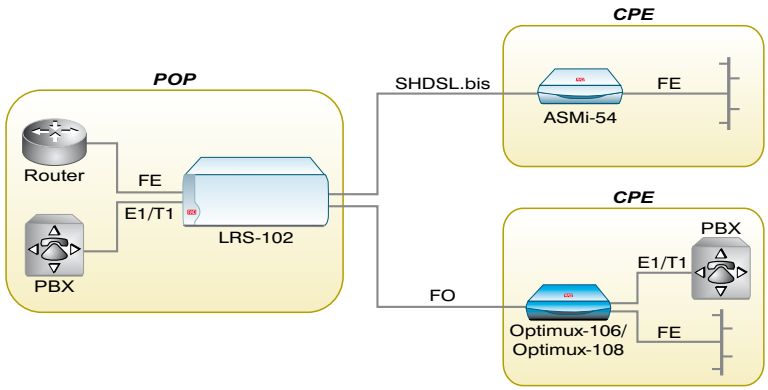
Cellular backhaul extension



Ethernet, voice, data, and video services over fiber optic link



E1/T1 Ethernet aggregation over fiber or copper and ring



E1/T1 and Ethernet over fiber or copper

Optimux-45, Optimux-45L

21 E1 or 28 T1 over T3 or Fiber Multiplexers

- **Multiplexes up to 21 E1 or 28 T1 channels over a single T3 (45 Mbps) or fiber link**
- **Cross connect capabilities for drop-and-insert and ring applications (Optimux-45 only)**
- **Simultaneous multiplexing of E1 and T1 channels (according to G.747 standard recommendations)**
- **T3 transmission over coax, fiber optic or wireless**
- **Multimode or single mode fiber**
- **Single fiber (WDM) and single fiber/wavelength option**
- **Range up to 110 km (69 miles)**
- **Optional secondary link provides automatic backup**
- **Optional redundant power supply**
- **Full management support (SNMP and Telnet) by RADview ASCII terminal, Web terminal or Telnet host**
- **E3, T1 and T3 statistical support**

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Optimux-45 and Optimux-45L are manageable multiplexers that provide a highly cost-effective and simple solution for transporting multiple E1 and T1 links, as well as a combination of E1 and T1 (according to ITU G.747), over a standard T3 electrical signal or fiber link. They provide flexible solutions to meet the specific requirements of a broad range of applications.

The Optimux-45 is an add and drop multiplexer, enabling it to support a wide range of applications. When deployed in a ring application, the Optimux-45 provides a complete path protection mechanism that prevents any service failure, even if a fiber link is damaged or disconnected.

Optimized for E1/T1 line quantity

To improve the price/performance ratio of the product, partial assemblies with four, eight or 12 ports are available, reducing the price significantly in nodes requiring only a small number of E1/T1 lines.

The Optimux-45 supports both balanced and unbalanced interfaces:

- Balanced version has RJ-45 connectors and supports up to 28 T1 channels (balanced 100 Ω), up to 21 E1 channels (balanced 120 Ω) or mixed E1 and T1 channels
- Unbalanced version has up to 21 mini-BNC connectors and supports up to 21 E1 channels (unbalanced 75 Ω)

The Optimux-45L is a low cost version of the Optimux-45 with Telco connectors as the user interface. The Optimux-45L is optimized for point-to-point or point-to-network applications only. This unit provides low cost connectivity of 21 E1 or 28 T1 lines or any combination of E1 and T1.

All versions are non-modular and offer redundant power supply, enhancing system reliability. In addition, an optional secondary link provides backup using automatic switchover upon main link failure.

Supports both electrical and optical interfaces

The products' main link supports both electrical and optical interface options. The electrical interface has BNC connectors in conformance with G.703 standards.

The optical interface supports the following options:

- 850 nm for multimode fiber
- 1310 nm for multimode fiber
- 1310 nm and 1550 nm laser for extended range over single mode fiber
- 1310 nm and 1550 nm long haul
- Single fiber option (WDM)
- Single fiber/wavelength option

To facilitate system diagnostics, the Optimux-45 and Optimux-45L feature LED status indicators as well as AIS alarm generation, and recognition and dry contact closure upon link failure. In addition, setup, control and diagnostics can be performed through a supervisory port using an ASCII terminal, Telnet host, Web terminal, or from an SNMP management station via a dedicated management port (Ethernet or RS-232).

Standards Compliance

The Optimux-45 and Optimux-45L conform to ITU G.703, G.747, G.823, G.824, ANSI T1.107, ANSI T1.404, RFC 3895, and RFC 3896.

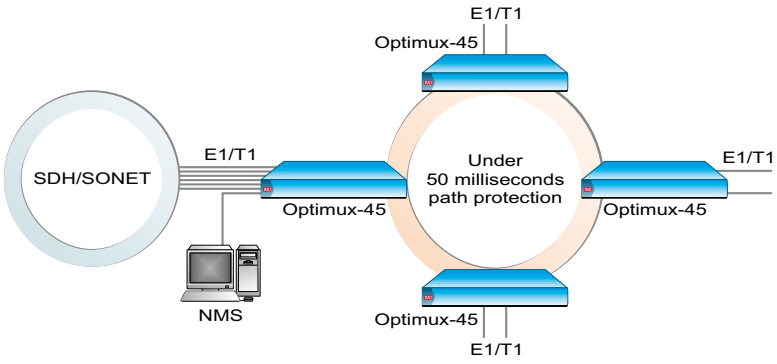
The SNMP management application offers:

- RADview-PC running in a Windows environment
- RADview-HPOV for HP OpenView UNIX platforms

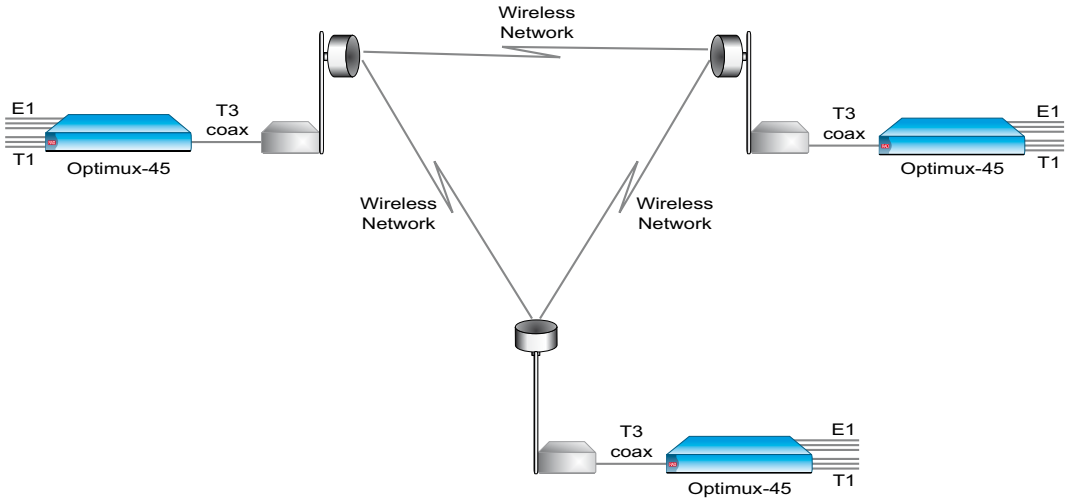
The T3 link via an optional clock interface can be locked onto an external station clock.

The products support various performance statistics on the E1, T1 and T3 lines.

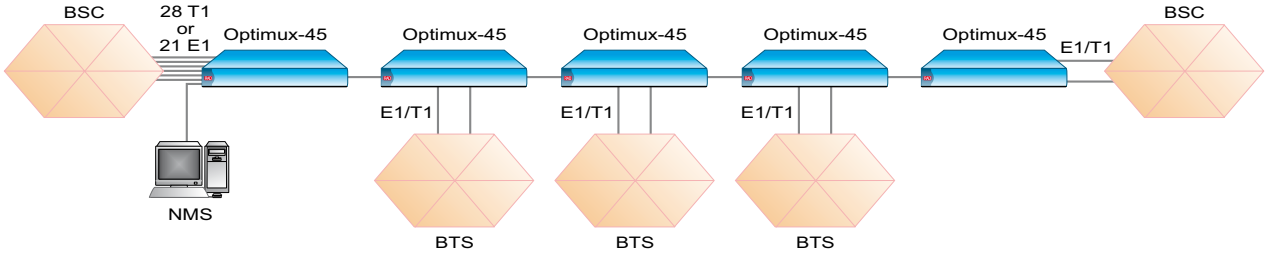
The Optimux-45 and Optimux-45L are available as compact 1U-high units for mounting in a 19-inch rack.



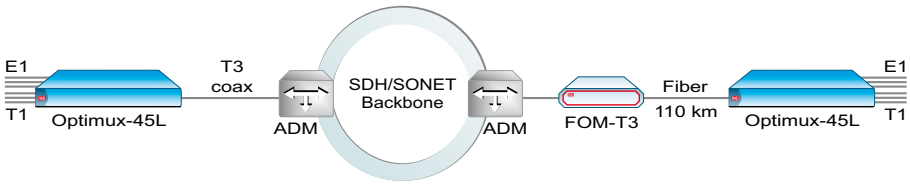
Ring topology for campus applications



Point-to-point over wireless links



Drop-and-insert for cellular infrastructure



Point-to-point over an SDH/SONET backbone

Optimux-34, Optimux-25

16 E1 or T1, Ethernet or Data over E3 or Fiber Multiplexers

- **Multiplexes up to 16 E1 or T1 channels and high speed data (V.35), or optional Ethernet traffic over a 34/25 Mbps link**
- **10/100BaseT Ethernet**
- **E3 (Optimux-34) or fiber optic cable**
- **Multimode or single mode fiber**
- **Single mode over single fiber or WDM**
- **Conforms to ITU G.703, G.742, G.751, G.823, G.824, G.955, IEEE 802.3**
- **Optional secondary link provides automatic backup**
- **Optional redundant modular power supply**
- **Management via an ASCII terminal, Web terminal or SNMP management application**

For latest updates visit www.rad.com

The Optimux-34 and Optimux-25 provide a simple and cost-effective solution for transporting multiple E1 or T1 links, as well as data or Ethernet, for distances up to 110 km (69 miles).

Optimux-34 supports up to 16 E1 channels, while Optimux-25 supports up to 16 T1 channels. A single 10/100BaseT Ethernet user port is optional. The bandwidth available for the Ethernet port can be adjusted by the user in gradations of 8 or 6 Mbps. The configuration options are:

- 16 E1/T1 only
- 12 E1 and 8.448 Mbps for Ethernet
- 12 T1 and 6.176 Mbps for Ethernet
- Eight E1 and 16.893 Mbps for Ethernet
- Eight T1 and 12.352 Mbps for Ethernet
- Four E1 and 25.334 Mbps for Ethernet
- Four T1 and 18.528 Mbps for Ethernet
- 32 Mbps for Ethernet only (Optimux-34)
- 25 Mbps for Ethernet only (Optimux-25)

The main link interface of the Optimux-34 can be either a standard coax E3 interface or a fiber optic interface. In the Optimux-25, only a fiber interface is available.

The following optical interfaces are available:

- 1310 nm and 1550 nm laser for extended range over single mode fiber
- 1310 nm and 1550 nm long haul for extended range over single mode fiber
- Single mode over single fiber (WDM) option

Multiple Ethernet transmission options

Ethernet transmission utilizes a single integrated 10/100BaseT LAN port. The Ethernet port can operate in half or full duplex mode, and supports auto-negotiation and transparent VLAN forwarding. IEEE 802.3x flow control and backpressure are also supported.

Power supply redundancy

The Optimux-34 and Optimux-25 offer modular, redundant power supply and secondary link options, enhancing system reliability. The optional secondary link provides backup using automatic switchover upon main link failure.

The Optimux-34 and Optimux-25 devices transmit each of the E1 or T1 tributary channels independently. The E1 interface can be 75 Ω unbalanced or 120 Ω balanced. The T1 interface is 100 Ω balanced.

The E3 interface clock in the Optimux-34 can be locked onto an external station clock.

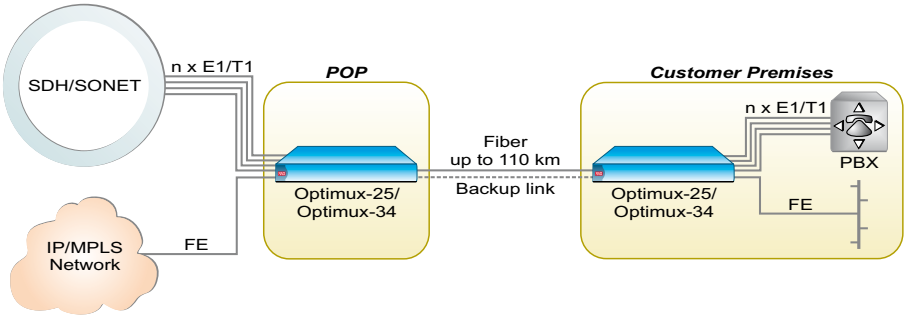
Diagnostics and management

To facilitate system diagnostics, both products feature LED status indicators, AIS alarm generation and recognition and dry contact closure upon link failure. In addition, setup, control and diagnostics can be performed through a supervisory port using an ASCII terminal, Telnet host or Web terminal, or from an SNMP management station via the Ethernet port or the dedicated management port (Ethernet or RS-232).

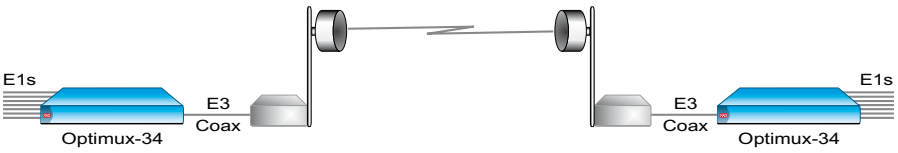
The SNMP management application offers:

- RADview for Windows environment
- RADview for HP OpenView UNIX platforms

The Optimux-34 is available as a compact 1U-high or 2U-high (E1 unbalanced only) unit, while the Optimux-25 is a 1U-high unit.

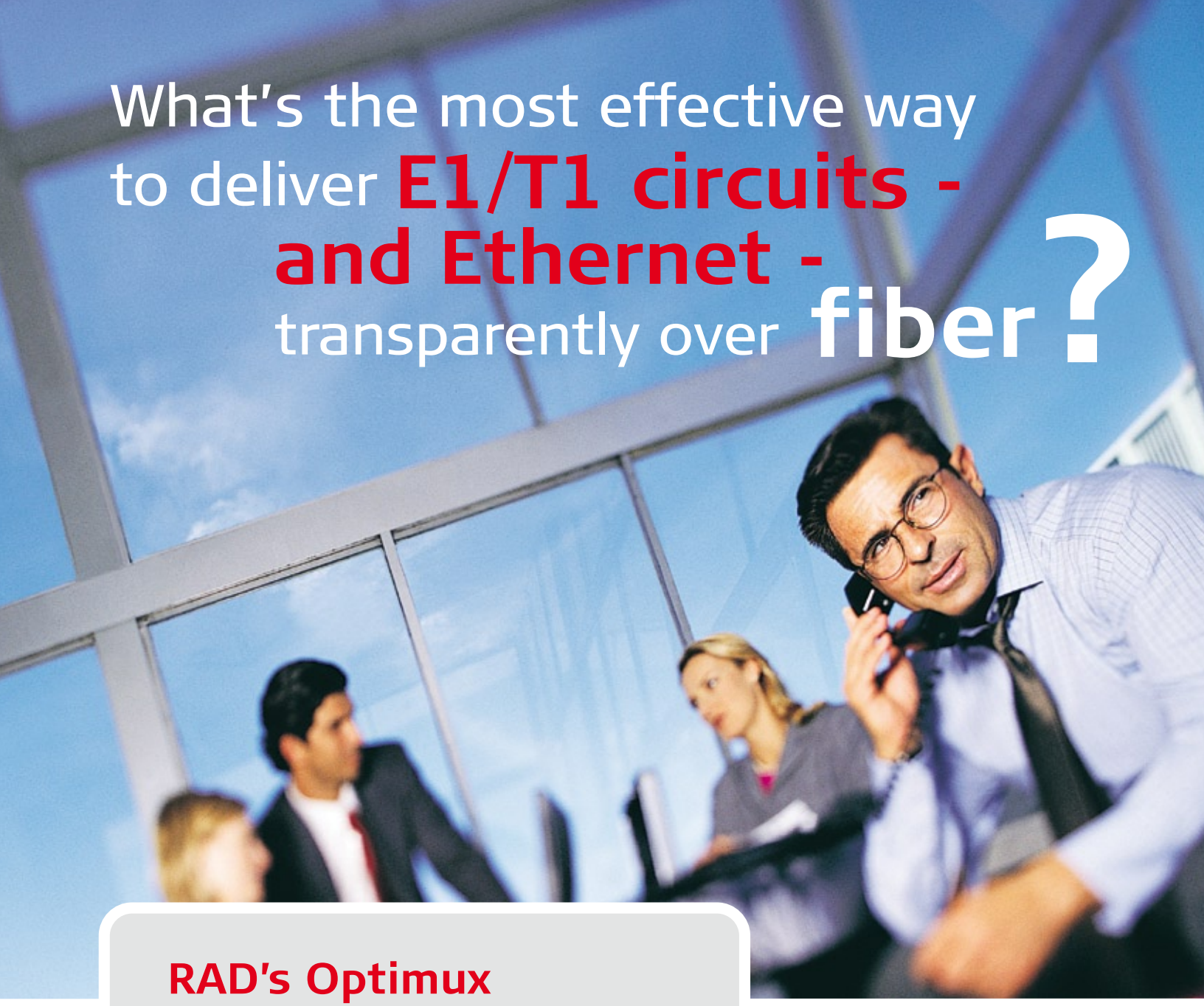


Ethernet, data and voice range extension



E1 fan-out over radio links

What's the most effective way to deliver E1/T1 circuits - and Ethernet - transparently over fiber?



RAD's Optimux Multiplexer Series

Optimux multiservice multiplexers are competitively priced, richly featured and built to last.

They support multiple E1/T1 – and Ethernet – transparently over fiber and coax connections, enabling you to deploy various services or backhaul radio traffic quickly.

Optimux-108/106
Ethernet and E1/T1 Multiplexer

Cost-effective multiplexer for extending the range of E1/T1 channels and Ethernet over a single link

RAD
data communications
The Access Company

E-mail market@rad.com | **www.rad.com**

Optimux-1551

Optimux-1551, Optimux-1553

STM-1/OC-3 Terminal Multiplexers

- **SDH/SONET terminal multiplexers connect lower rate PDH services over a single STM-1/OC-3 (155 Mbps) link**
- **Optimux-1551 multiplexes up to 63 E1 or 84 T1 tributary channels**
- **Optimux-1553 multiplexes three E3 or three T3 tributary channels**
- **Channelized STM-1/OC-3 main link with standard fiber optic (single mode, multimode and WDM) or coaxial interface**
- **Supports 1+1 unidirectional automatic protection switching (APS) on STM-1/OC-3 uplink; 1+1 protection on DS1 or DS3 tributaries and power supply modules**
- **Provides a demarcation point between the carrier network and the customer network**
- **Includes SNMP agent, RS-232 and Ethernet management ports**
- **Configuration, service, performance, security, and fault management via ASCII terminal, Telnet or RADview network management systems**
- **Range up to 80 km (50 miles)**
- **Plug-and-play**

For latest updates visit www.rad.com

Optimux-1551 and Optimux-1553 terminal multiplexers deliver traditional PDH services over existing SDH/SONET networks. They combine the high capacity associated with SDH/SONET add and drop multiplexers (ADMs) with the simplicity and low cost of a terminal multiplexer, significantly reducing operating and capital expenses (OpEx and CapEx).

High capacity in a compact unit

The 2U-high Optimux-1551 provides connectivity for up to 63 E1 or 84 T1 lines, and the 1U-high Optimux-1553 provides connectivity for three E3 or three T3 lines. The products comply with all SDH/SONET standards, and interface with existing SDH/SONET backbones through a single or redundant STM-1, OC-3 or STS-3 interface.

The Optimux-1551 can be ordered with 21 x E1/28 x T1 channels, 42 x E1/56 x T1 channels or 63 x E1/84 x T1 channels.

Carrier-class design

Designed for the rigorous requirements of carriers and service providers, Optimux-1551 and Optimux-1553 devices offer a high level of reliability and manageability. Hardware redundancy is designed into the system without the need for custom Y-cables or external devices. This 1+1 redundancy is provided for all user interfaces through an optional second, hot-swappable multiplexer card. 1+1 redundancy is also available for the STM-1/OC-3 main link (unidirectional APS/MSP) and power supply modules. This reliable platform maximizes uptime for mission-critical applications. A fully equipped Optimux-1551 fits in a single 2U-high 19-inch shelf while the Optimux-1553 occupies a 1U-high shelf.

Higher revenues at lower cost

The Optimux devices allow service providers to extend their network to remote customers, thereby enlarging their customer reach and increasing revenues, without the expenses associated with deploying high-end ADMs, which add unnecessary cost and complexity in point-to-network connections. Compared to the alternative of deploying PDH multiplexers at customer sites, the Optimux devices interface directly with the existing SDH/SONET TDM infrastructures and consolidate traffic at the edge of the network. This enables service providers to save the cost of fiber deployment and of multiple ports on the ADM.

Plug-and-play operation

Easy to install, maintain and operate, Optimux products require no training or expertise. As completely plug-and-play units, the products allow carriers to extend the benefits of SDH/SONET networks to the customer premises or central office in a quick and inexpensive manner.

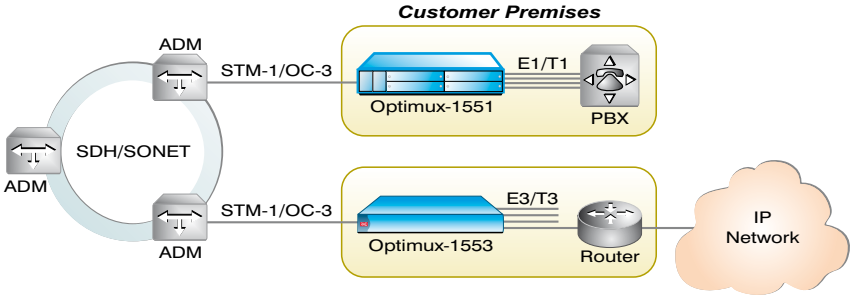
Typical applications

Optimux devices are especially suitable for extending SDH/SONET network services toward remote and suburban locations such as industrial areas and business parks. They are the ideal choice for delivering multiple E1/T1 or E3/T3 services.

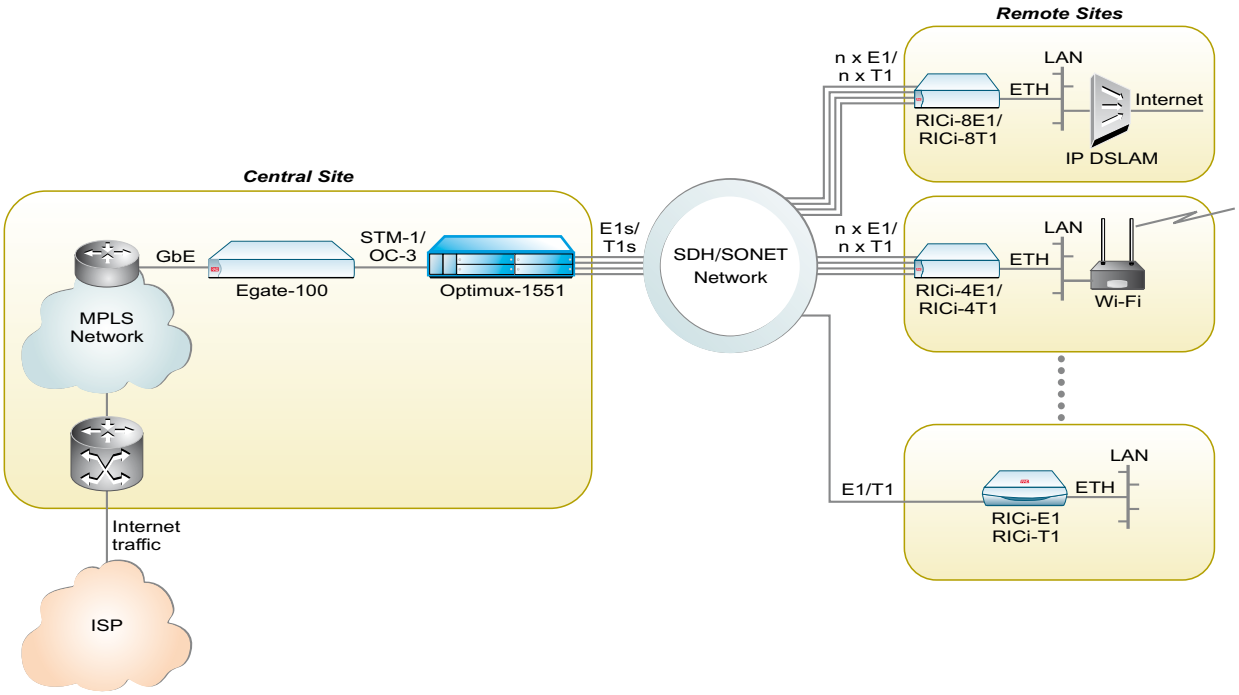
The Optimux units can be deployed in point-to-point applications, connecting two sites over fiber, to distances of up to 80 km (50 miles).

A service provider can use Optimux-1551 to deliver E1/T1 services and Internet access to multiple customers, and use Optimux-1553 to provide E3/T3 lines to large enterprises with higher bandwidth requirements. Together with Optimux-34 (for E3) or Optimux-45/45L (for T3), RAD's Optimux-1553 can be used to combine E1/T1 and E3/T3 services over a single STM-1/OC-3 line.

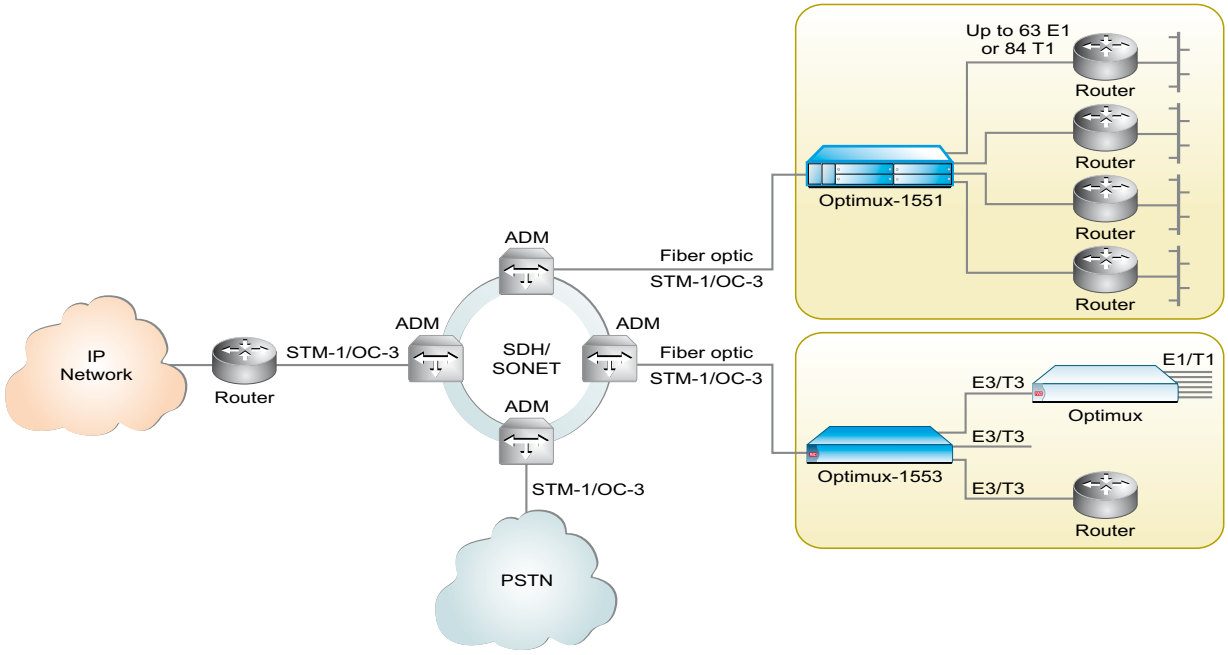
The units are 19-inch wide, and 2U-high for the Optimux-1551 and 1U-high for Optimux-1553.



Fan-out services from standard equipment



End-to-end Ethernet over SDH/SONET/PDH



Delivering E1/T1, E3/T3 and Internet access to multiple customers

FCD-155

STM-1/OC-3 Terminal Multiplexer

- **Standard next-generation STM-1/OC-3 terminal**
- **Grooms Ethernet and E1/T1/E3/T3 traffic over STM-1/OC-3 fiber or copper links**
- **Multiservice functionality in the same box:**
  - **Two or six 10/100BaseT ports or one GbE port**
  - **Four or eight E1/T1 ports or one E3/DS3 port**
- **SFP-based uplinks and Gigabit Ethernet**
- **Advanced management option including DCC and IP tunneling**
- **Available with standard protection on the main link**
- **Compact size**

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The FCD-155 terminal multiplexer delivers next-generation Ethernet services as well as traditional traffic over SDH/SONET networks. Installed at the customer site, the FCD-155 leverages the SDH/SONET infrastructure for Internet access and LAN connectivity, while providing continued support for all E1/T1/E3/T3 services.

Improves bandwidth efficiency

The FCD-155 connects LAN traffic over SDH/SONET networks. Support for generic framing procedure (GFP) or X.86 encapsulation with virtual concatenation enables configuring the bandwidth of the IP channel in increments of 2 Mbps (VC-12), 1.5 Mbps (VT 1.5) or 48.384 Mbps (VC-3 or STS-1), up to 100 Mbps wire-speed, for cost-effective adaptation of the SDH/SONET infrastructure for LAN connectivity. FCD-155 eliminates the rigid bandwidth restrictions usually imposed by SDH/SONET virtual containers, and allows for scalable and efficient next-generation Ethernet services delivery over voice-oriented networks.

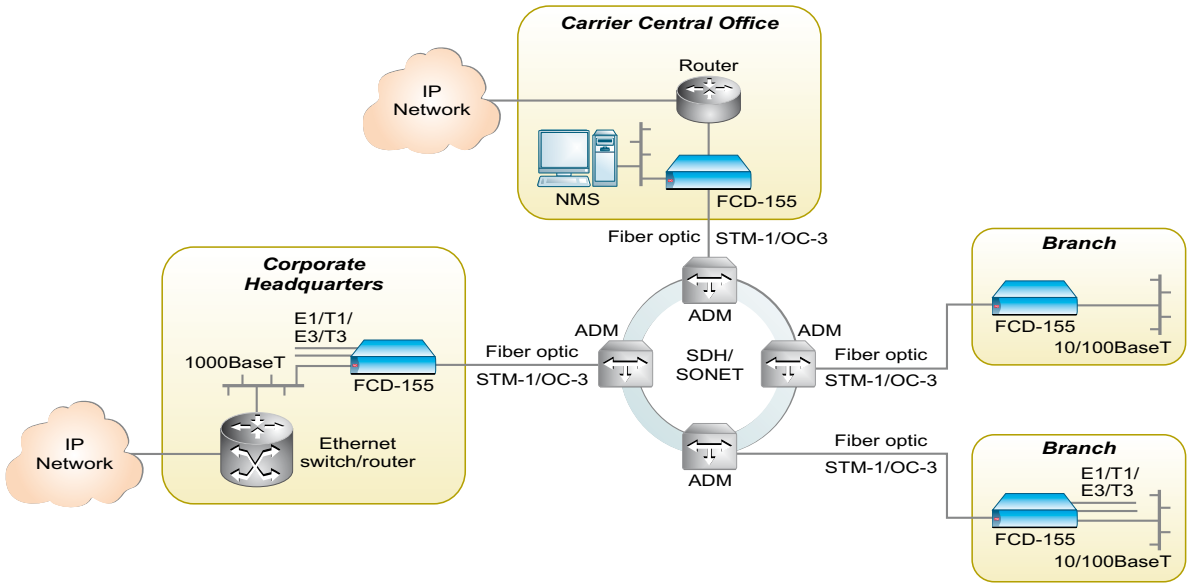
Multiservice offering

In addition to transporting next-generation IP services, the FCD-155 continues to support E1/T1 or E3/T3. The E1/T1 or E3/T3 traffic is mapped into the SDH/SONET frame and can be terminated at any point on the network.

Reduces costs, increases revenues

The FCD-155 brings Ethernet economics and packet switching efficiency to existing SDH/SONET infrastructures. It thereby enables carriers and service providers to reduce both OpEx and CapEx, as they leverage optical bandwidth for revenue-generating , high bandwidth Ethernet services.

A service provider serving enterprise customers benefits from better bandwidth utilization on the network (for example, a user who needs 10 Mbps LAN will use five VC-12 or seven VT 1.5 links instead of a full 48.384 Mbps VC-3 or STS-1 connection), and gains the ability to offer service granularity similar to next-generation Ethernet networks. End users benefit from lower costs and a larger selection of services that can better meet their specific connectivity requirements.



Point-to-multipoint application

FCD-155E

Ethernet and E1/T1, E3/T3 SDH/SONET ADM

The FCD-155E SDH/SONET add and drop multiplexer delivers next-generation Ethernet services as well as E1/T1 and E3/T3 traffic over SDH/SONET networks. Installed at the customer site or directly on STM-1/OC-3 access rings, the FCD-155E leverages the SDH/SONET infrastructure for Internet access and LAN connectivity, while providing continued support for E1/T1 and E3/T3 services.

Improves bandwidth efficiency

The FCD-155E connects LAN traffic by creating an SDH/SONET network. Support for generic framing procedure (GFP) or X.86 encapsulation with virtual concatenation enables configuring the bandwidth of the IP channel in increments of 2 Mbps (VC-12), 1.5 Mbps (VT 1.5) or 50 Mbps (VC-3 or STS-1), up to 100 Mbps wire-speed, for cost-effective adaptation of SDH/SONET infrastructure for LAN connectivity. FCD-155E eliminates the rigid bandwidth restrictions usually imposed by SDH/SONET virtual containers, and allows for scalable and efficient delivery of next-generation Ethernet services over voice-oriented networks.

Multiservice offering

In addition to transporting next-generation IP services, the FCD-155E continues to support E1/T1 and E3/T3 services. The traffic is mapped into the SDH/SONET frame and can be terminated at any point on the network.

Reduces costs, increases revenues

The FCD-155E acts as a LAN and E1/T1 or E3/T3 terminal as well as an STM-1/OC-3 ADM. Incorporating these functions in a single device reduces the number of units needed and lowers implementation costs.

The FCD-155E brings Ethernet economics and packet switching efficiency to SDH/SONET infrastructure. It thereby enables carriers and service providers, as well as private fiber network owners such as utilities and campuses, to reduce both OpEx and CapEx as they use their optical bandwidth for revenue-generating Ethernet services. For a modest investment, SDH/SONET carriers can tap into new business opportunities while leveraging their existing equipment to support clear channel data streams and the latest high bandwidth services.

Service providers addressing enterprise customers benefit from better utilization of network bandwidth (for example, a user who needs 10 Mbps LAN will require five VC-12 or seven VT 1.5 links instead of a full 48.384 Mbps VC-3 or STS-1 connection), and have the ability to offer service granularity similar to next-generation Ethernet networks. End users benefit from lower costs and a larger selection of services that can better meet their specific connectivity requirements.

- **Standard next-generation STM-1/OC-3 ADM**
- **Grooms Ethernet and E1/T1/E3/T3 traffic over STM-1/OC-3 fiber or copper links**
- **Multiservice functionality in the same box:**
  - **Two or six 10/100BaseT ports or one Gigabit Ethernet port**
  - **Eight or 21 E1/28 T1 ports, one E3/DS3 port or 21 E1/28 T1 and one E3/T3**
- **Optional dual power supply configuration**
- **Available with standard protection on the main links**
- **Compact size**
- **SFP-based STM-1/OC-3 uplinks and Gigabit Ethernet (SFP and UTP)**
- **Advanced management option via DCC and IP tunneling**

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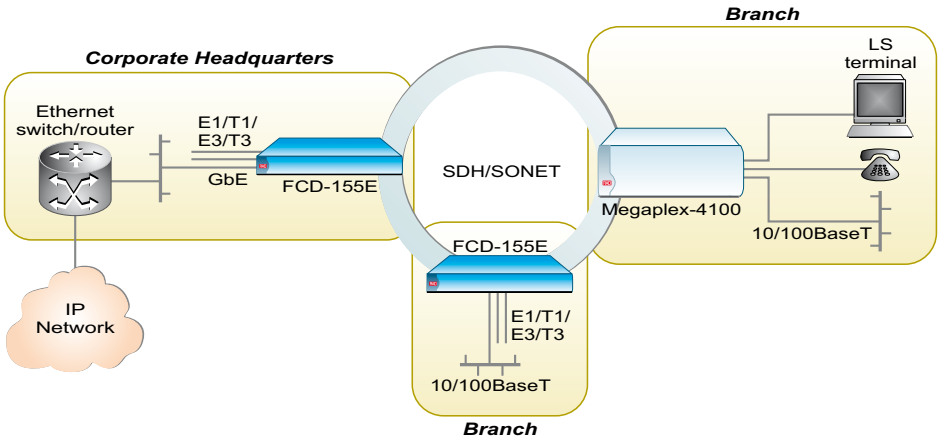

Point-to-point application

IMXi-4

Managed Inverse Multiplexer

- **Connects a high speed switch or router channel over up to four SHDSL or E1/T1 links; throughput up to 8.3 Mbps**
- **User-selectable bridge or router modes**
- **Employs VLAN tagging and stacking for providing transparent LAN services (TLS)**
- **10/100BaseT Ethernet user port**

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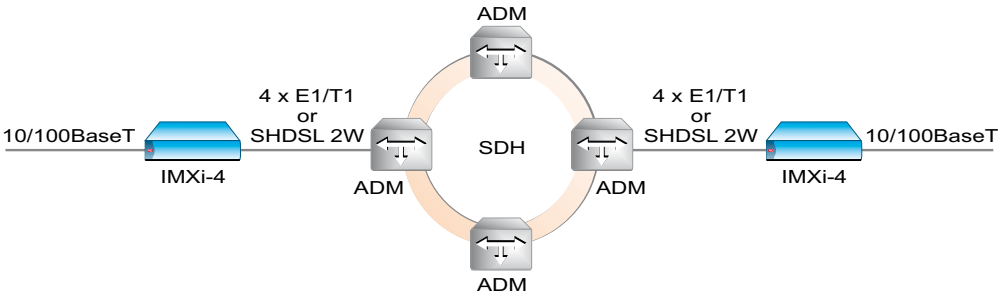
The IMXi-4 inverse multiplexer splits a single high speed channel of up to 8.3 Mbps, and transmits it over up to four E1/T1 or SHDSL network links. IMXi-4 bridges the bandwidth gap between E1/T1 and E3/T3 services, while providing the flexibility to increase throughput from one to four lines as network requirements grow. Automatic rate fallback ensures continued transmission even if an individual link fails.

RAD's IMXi-4 enables enterprises and service providers to use the same device for Ethernet or IP environments. When operating in bridge mode, user LAN traffic can be VLAN tagged or stacked for transparent transport. The user port has a 10/100BaseT interface.

Using SHDSL links, IMXi-4 can extend Ethernet service coverage to reach more customers. 2.0 Mbps/1.5 Mbps traffic can be transported up to 6.6 km (4.1 miles) over copper lines, without the need for additional equipment. SHDSL support adds flexibility, enabling an increase in the distance by adjusting the data rate, while enlarging the total throughput to 8.3 Mbps.

Local and remote IMXi-4 units can be managed by RADview-EMS, an SNMP CORBA-based multiplatform element management system, allowing remote troubleshooting and configuration. The units can also be managed via Telnet or an ASCII terminal through a dedicated timeslot.



Ethernet over bonded E1/T1 or SHDSL circuits

Kilomux-2100, Kilomux-2104

Subrate Multiservice Multiplexers

TDMoIP Driven®

The Kilomux subrate multiservice multiplexers provide an efficient and cost-effective solution for integrating data, voice, fax, and LAN traffic over digital data services, leased lines, IP, ISDN, and other services. Access to the various services is provided over a variety of standard interfaces at data rates ranging from 9.6 kbps to 1,536 kbps.

The low overhead, minimal end-to-end delay and allocated bandwidth of the Kilomux – together with voice compression – ensure quality of service while maximizing utilization of the available bandwidth.

Main link modules

Many interfaces are available on the aggregate links for compatibility with digital data services worldwide. These include V.35, V.36/V.11, RS-530, V.24/RS-232, X.21, and G.703 codirectional. Built-in CSU/DSU, fractional E1/T1, fiber optic, ISDN terminal adapters, and TDMoIP are also available. Soft-selectable timing options from either the link or any channel are standard for all interfaces, as is support for control signals.

Standard 8-bit buffers on both the transmit and receive lines, as well as an optional on-board 256-bit satellite buffer, enable the use of any type of access media. These include leased lines, fiber, radio, microwave, and satellite links.

The Kilomux-2100 supports a secondary link, which can be configured in several ways:

- As a backup link, which can be connected to a dial-up modem, switched digital service or ISDN basic rate line.
- As an active, secondary link with load sharing option providing double capacity. This mode supports "priority bumping," which allows the most important channels to continue functioning in the event of a failure on either link.
- As an additional, active link, thus enabling communication with two independent Kilomux units at different sites. In this configuration, the KDI module can provide drop-and-insert and bypass capabilities between the two links.

Main link modules include:

KML.1/N for V.35 interface

KML.2/N for V.24/RS-232 interface

KML.3/N for V.36/RS-422/RS-530 interface

KML.4/N for X.21 interface

KML.5/N for G.703, codirectional interface

KML.6/N CSU/DSU for standard DDS (US) or built-in short range modem (9.6, 19.2, 56 kbps)

KML.7 for fractional T1 interface

KML.8 for connection to a fractional E1 interface

KML.10 built-in ISDN terminal adapter for one or two "B" channels; supports dedicated or switched connection

KML.F fiber optic main link eliminates the need for an external fiber optic modem

KML.11 TDM over IP main link enables the Kilomux payload to be delivered over IP networks

System modules

KCL.2
Common logic module featuring built-in SNMP agent, software download and optional integrated Ethernet port for management

KPS.3, KPS.5, KPS.7, KPS.8
Power supply modules

KDI
Drop-and-insert and bypass module can be used in situations where the Kilomux at the central site is communicating with two remote sites and voice/data communication is required between the remote sites. In addition, it can provide support for ring topologies and a single multidrop channel.

KM-Ringer provides DC feed and ringer voltage for voice modules with FXS interface

KAI
Alarm indication module for rear panel viewing of most front panel indicators

Timing options

Various timing options for both the link and the I/O channels assure integrity of data transfer in any application. DTE, DCE and external DCE clocking are supported by the main link (not applicable on G.703 or CSU/DSU).

I/O modules

I/O modules are available for many types of traffic. Low and high bit rate data (sync and async) channels can be combined with voice and fax circuits for maximum bandwidth utilization. Advanced technology in voice compression allows a choice between toll-quality ADPCM, PCM or high quality, low bit rate compressed voice, at rates as low as 4.8 kbps. In addition, internetworking modules provide LAN (Ethernet) connectivity.

Any combination of up to four or 12 I/O modules can be configured in the Kilomux-2104 and Kilomux-2100 chassis respectively.

- **Connects to leased lines, IP, ISDN, radio, satellite, and DDS links**
- **Link data rates from 9.6 kbps to 1,536 kbps**
- **High quality, low bit rate voice/fax from 4.8 kbps to 14.4 kbps**
- **Two chassis types:**
  - **Kilomux-2100 with 12 I/O slots**
  - **Kilomux-2104 with four I/O slots**
- **Optional redundant power supply and link interface**
- **Supports up to 180 digital voice or fax channels and 96 analog channels in one box**
- **Supports up to 48 async or 24 sync data channels**
- **Drop-and-insert capability**
- **Ethernet IP/IPX router/bridge module for LAN connectivity**
- **Flexible timing options**

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Kilomux-2100, Kilomux-2104
(Continued)

Data modules

KLS.1/N
Low speed module supports two sync or async RS-232/V.24 data channels. Selectable data rates from 300 bps to 64 kbps.

KLS.2
Statistical multiplexing data module supports four async RS-232/V.24 channels. Selectable data rates from 300 bps to 19.2 kbps.

KHS.1
High speed module supports two sync data channels with V.35, RS-449/RS-422 or X.21 interface. Supported data rates are 32, 48, 56, 64, 128, 192, 256, and 384 kbps.

KHS.2
High speed module supports two sync data channels with V.35/RS-530, V.36/RS-530 or V.24/RS-232 interface. Supported data rates:

- n x 2.4 kbps for link rates up to 192 kbps
- n x 4.8 kbps for link rates of 256 kbps and 384 kbps
- n x 9.6 kbps for link rates of 512 kbps and higher

KHS.U
High speed module with one data channel, supports ISDN basic rate services even over non-ISDN facilities such as dedicated leased lines. The KHS.U operates either as NT (network termination) or LT (line termination).

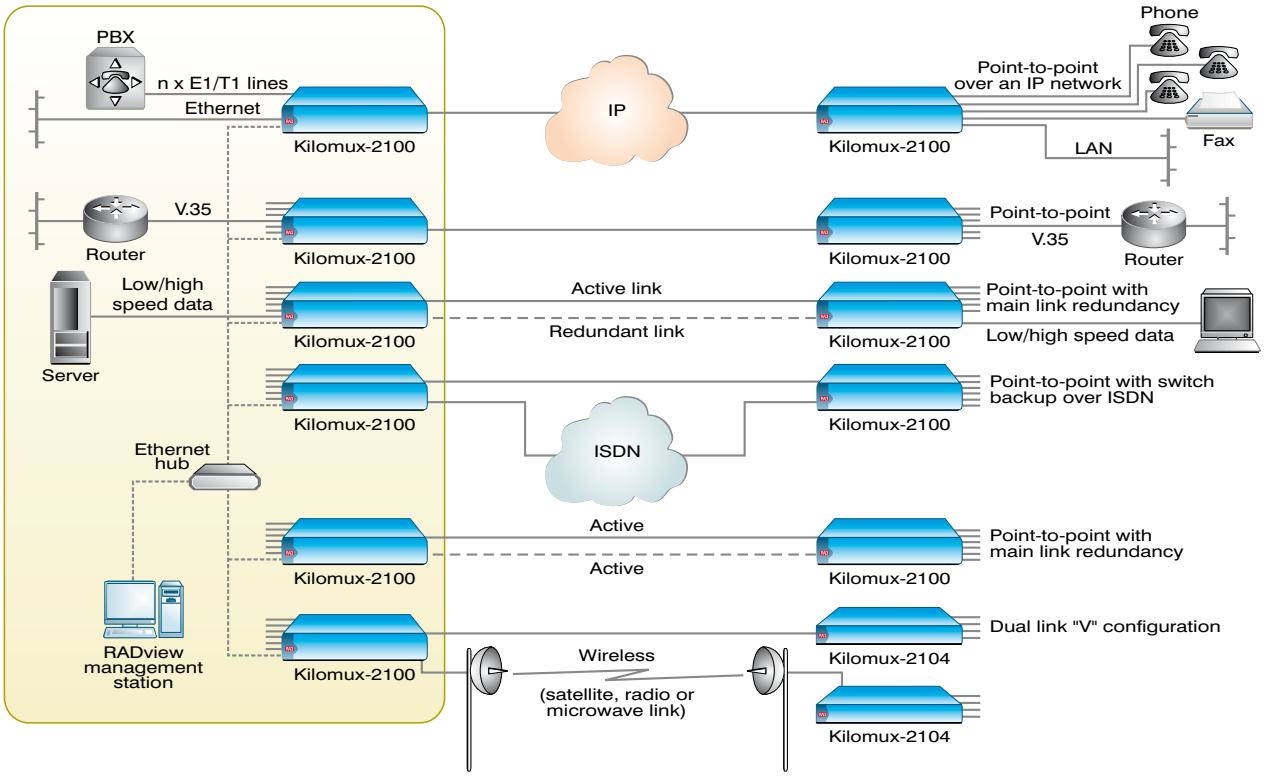
KHS.703
High speed module supports two 64 kbps G.703 codirectional channels.

Voice modules

KVC.1M
Voice module supports two analog voice channels with ADPCM encoding at 16, 24 or 32 kbps. Also supports PCM encoding at 64 kbps (A-law). Modular analog interfaces are 2/4-wire E&M, 2-wire FXS, FXO, and FXSP. Additionally, it offers pulse metering at 16 or 12 kHz and polarity reversal, as well as optional echo cancellation.

Voice/fax modules

KVF.4
Voice/fax low bit rate module uses the ITU G.723.1 voice digitizing technique to provide toll-quality voice at 6.4 kbps for two analog channels or an ISDN S interface channel (including D-channel compression). The card can digitize voice at rates from 4.8 kbps to 12.8 kbps and offers pulse metering at 16 or 12 kHz and polarity reversal as well as integral echo canceller. Analog interfaces supported are E&M, FXO, FXS, and FXSP.



KVF.6

Voice/fax low bit rate module uses the ITU G.723.1 voice compression algorithm to provide toll-quality voice at 6.4 kbps for a full E1 or T1 trunk. The card can digitize voice at rates from 4.8 kbps to 16 kbps and supports inband transparent fax transmission at rates of up to 14.4 kbps. The dual-slot module supports both CAS (DTMF, R2) and CCS (SS7, PRI) signaling methods.

KVF.8

Voice/fax low bit rate module uses the G.723.1 digitizing technique to provide toll-quality voice at 6.4 kbps for eight analog channels. The card can digitize voice at rates from 4.8 kbps to 16 kbps and supports inband transparent fax transmission rates of up 14.4 kbps. The card offers pulse metering at 16 or 12 kHz and polarity reversal as well an integral echo canceller.

All KVF modules support inband fax for transparent fax transmission as well as V.22 and V.22bis modem data transmission. KVF.6 and KVF.8 also support V.32bis modem data transmission.

Internetworking modules

KMBE

Ethernet IP/IPX router/bridge module supports the connection of up to 256 remote workstations to a main Ethernet LAN in bridge mode, and to an unlimited number of workstations in router mode. Bandwidth from 9.6 kbps to 1,280 kbps is supported on the link. Interface can be AUI, thin coax or UTP (10BaseT). The module includes all the features of the WEB RANger-II such as Single IP, Solid Firewall™ and RADview SNMP management.

Management options

The Kilomux offers three management options:

- **ASCII terminal** – an ASCII terminal can be connected locally or remotely, using a dial-up modem.
- **Telnet** –a Telnet client can be used to control the Kilomux via its Ethernet management port or via an inband management channel.
- **RADview management station** – enables complete monitoring and control from a central management station. RADview provides direct online supervision, configuration and diagnostics.

The Kilomux devices include an SNMP agent and can be managed using RADview-PC or RADview-HPOV (on a UNIX platform) graphical user interface. This provides terminal access to remote devices from any management station on the network for configuration and troubleshooting.

Online supervision

Audio and visual indicators provide the status of alarms and tests at the network, multiplexer, card, and port levels and include all links connected to the Kilomux. Alarms are automatically logged and presented upon request unless otherwise masked.

Sanity check

Configurations are automatically checked for validity before being downloaded or upon user request. This check can be performed at three different levels: the whole network, one single rack or per module or channel.

Manual timeslot allocation and bypass

Network-level operations enable easy activation of drop-and-insert applications. An existing configuration can be copied to a desired destination within the same Kilomux or to any other Kilomux. This operation can be performed at the Kilomux, card or channel level.

Database

All configuration parameters are stored in non-volatile memory to ensure data integrity in the event of a power failure. A secondary database may also be programmed for time-of-day bandwidth allocation or switched backup operation. Alarm information is collected and stored in memory for easy reading by the management system.

Diagnostics

The Kilomux incorporates numerous test features for easy maintenance and rapid fault detection. Upon operation and during normal use, automatic self-test and link-test are performed, and all problems are reported to system management.

Local and remote loops can be performed for each main link and every I/O channel. A built-in BERT can be used for testing any I/O data channel and a built-in tone injection can be used for testing any voice channel. These extensive diagnostic tests ensure quick fault discovery and recovery.

Compact chassis models

For applications requiring a small number of I/O channels, the compact Kilomux-2104 model is available. This modular unit, packaged in a 1U-high enclosure, supports four I/O modules. It accommodates up to 16 asynchronous data channels, up to eight synchronous data channels, or up to 32 analog/60 digital voice or fax channels over a single link interface. The Kilomux-2104 is fully compatible with the Kilomux-2100.